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The Role of Information Technology in Industry-Education Integration Policies: Evolutionary Trends and Future Prospects in China's Vocational Education

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Abstract. This research explores the evolution and key characteristics of vocational education policies in China, focusing on the role of information technology in enhancing industry-education integration. A combination of literature review, textual analysis, and statistical analysis was employed for word frequency analysis of policy texts using ROST CM 6.0. The findings revealed that China's vocational education policies have progressed through four stages: rebuilding (1978-1995), development and consolidation (1996-2002), exploration and innovation (2003-2013), and advancement and deepening (2013-present). The integration of information technology in recent years has driven innovation in vocational education, improving training programs and better aligning them with market demands. This led to the development of skilled labor and played a vital role in China's economic transformation. The study provides valuable insights into how future policies can leverage information technology to further enhance industry-education collaboration.

Keywords: industry-education integration, information technology, vocational education policies

1 Introduction

1.1 Background

The merging of industry and vocational education, combined with the integration of information technology, has emerged as a crucial and transformative trend in contemporary education. This approach is increasingly seen as a key strategy for aligning talent development with industry needs, particularly in the context of rapid technological advancements. By aligning educational objectives with real-world industry demands, and incorporating the latest IT tools and platforms, this approach ensures that students are not only knowledgeable in theory but are also equipped to effectively handle the requirements of the job market.

Industry-education integration, powered by information technology, marks a revolutionary shift from traditional vocational education models, which often prioritized theoretical knowledge with limited exposure to actual industry practices. This contemporary integration approach embeds practical industry collaboration and digital tools into the educational framework. The partnership between educational institutions, industries, and IT platforms allows students to gain firsthand experience and digital skills, making them more adaptable and responsive to real work environments. Through practical engagements and the use of digital technologies, students can interact directly with industry professionals, participate in real-world projects, and gain a deep understanding of the dynamics and demands of their chosen fields. This practical experience is invaluable, as it not only sharpens their technical abilities but also develops crucial soft skills like problem-solving, teamwork, and communication. Graduates are better prepared to transition smoothly into the workforce, especially in industries that rely heavily on technological competencies.

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Furthermore, industry-education integration promotes innovation and ensures that educational curricula, enriched by the latest IT developments, remain aligned with current industry trends and technological advancements. This synergy creates a feedback loop in which industry input and IT advancements shape educational programs, ensuring that the skills taught are relevant, up-to-date, and technologically grounded. The result is a workforce that is well-equipped to meet current demands and to drive future growth and innovation, particularly in technology-driven sectors.

In summary, integrating industries and information technology with vocational education exemplifies a proactive strategy that is aligned with the changing demands of the contemporary economy. It transforms traditional education models by incorporating both practical industry experiences and digital innovations, thereby improving students' readiness for the workforce and ensuring that educational institutions remain agile and adaptable to industry and technological changes. This trend is not only beneficial but is essential for developing a dynamic, skilled, and adaptable workforce capable of meeting the challenges of both current and future industries in a tech-centric world.

1.2 Research Purpose

This study aims to provide a comprehensive analysis of the key characteristics and evolution of China's vocational education policies, focusing on the role of IT in promoting industry-education integration. Its three primary objectives include: (1) to explain the historical evolution of vocational education policies, examine their development path since the reform and opening-up, and identify the main areas of emphasis and the distinctive features of policies at each stage, highlighting the incorporation of information technology; (2) to assess the effects and social impacts of these policies, evaluating their influence on the quality, structure, and integration of technology in vocational education, and their contribution to social and economic progress; and (3) to provide informed policy suggestions and directions based on historical and current analysis, offering recommendations for current and future vocational education policies, with a focus on strengthening the collaboration between industry and education through the use of information technology, encouraging digital innovations, and enhancing the overall quality of education.

2 Literature Review

2.1 The Emergence and Impact of Industry-Education Integration in China's Vocational Policies

The deep collaboration between education and industry has emerged as a key topic in global vocational education research, prompting scholars to examine its origins, development, and significance. Shavit and Müller traced the concept back to the late 20th century when vocational education reforms became necessary due to industrialization. Traditional models failed to meet the required skills demanded by emerging industries, leading policymakers to align vocational education with industry needs [1]. Gleeson and Keep explored how changes in corporate involvement in the UK education system influenced the formation of industry-education integration, shaped by evolving relationships between employers, the state, and the education sector [2].

The importance of industry-education integration is widely recognized. Wheelahan emphasized that incorporating real-world work experience into vocational education is crucial for improving students' employability by enhancing their practical skills and ability to adapt to changing work environments [3]. Rauner and Maclean highlighted it as essential for improving vocational education quality and aligning it with labor market demands [4]. Billet further stressed that this integration helps students acquire both theoretical knowledge and practical skills to better meet industry requirements [5].

In China, industry-education integration was first formally introduced in national policy through the "Decision of the Central Committee of the Communist Party of China on Major Issues Concerning Comprehensively Deepening Reforms", released in 2013. In this context, "industry" pertains to the industrial sector, "education" refers to the educational sector, and "integration" involves the process through which, after substantial interaction, the goals and directions of disparate entities or groups gradually converge.

In summary, although the development paths of industry-education integration differ from each country, the core objective remains the same: to cultivate highly skilled talents that meet market demands through deep col-

laboration between education and industry. This global consensus on the concept highlights its importance and universal applicability in modern vocational education systems.

2.2 Research on the Development of Industry-Education Integration Policies and Policy Texts

Given the variations in economic backgrounds and educational systems, various countries have developed distinct models of industry-education integration tailored to their specific needs. Among the more mature models are Germany's "Dual System" and the United States' "Cooperative Education"; other noteworthy models include Australia's "TAFE" model and the UK's "Sandwich Education" model.

According to Thelen, the success of Germany's dual system lies in its high level of institutionalization and industry participation [6]. Deissinger further explored the operational mechanisms of the dual system and observed that the key to its success is the partnership between educational institutions and companies. Regarding international applicability [7], Rauner and Maclean argued that although the dual system is very successful in Germany, its implementation in other countries often faces challenges related to institutional, cultural, and economic environments [4]. Euler also pointed out that although the dual system is highly effective in Germany, other countries must take into account cultural, economic, and institutional differences before its implementation [8].

The American educator Herman Schneider was the first to propose the concept of cooperative education to train students to become applied engineers. Dressler and Keeling analyzed the long-term effects of cooperative education on students' careers and found that those who participated in cooperative education demonstrated stronger career adaptability and earned higher starting salaries upon entering the workforce [9]. Coll and Eames discussed the impact of cooperative education on enhancing students' soft skills, such as teamwork and communication abilities [10]. Linn, Howard, and Miller explored the long-term impacts of cooperative education and noted that students who participated in cooperative education exhibited greater competitiveness and higher job satisfaction in their careers [11].

In recent years, research on industry-education integration has markedly increased, establishing it as a prominent subject of interest in both the educational and industrial fields. The concept of "industry-education integration" was first introduced by Shi and Chen, focusing on enhancing internship quality at vocational schools in Wuxi, Jiangsu Province [12]. China officially integrated the concept into its policies in November 2013. Scholars analyzed the policy changes with diverse perspectives. Wang examined the evolution based on textual content, discursive practices, and social practices, and noted that policy changes are predominantly reflected in the shifting concept of industry-education relationships, the dependency on policy reforms, and the signaling of positive discourse [13]. Xiao and Hu analyzed 53 policy documents, scrutinizing both their attributes and content, and found persistent issues in policy formulation and implementation. They recommended enhancements to the legal foundation, specificity, and operability of policies, improved coordination among stakeholders, and greater effectiveness of policy tools [14].

While the models of industry and education integration in China differ in other countries in terms of background, systems, and implementation paths, the core objective remains the same: to develop a highly skilled and adaptable workforce that meets market demands through education and industry collaboration. China's industry-education integration policies have made significant progress in recent years, with policy-driven initiatives and enhanced collaboration further advancing the quality of education and boosting students' employability.

2.3 The Role of Information Technology in Vocational Education and Industry-Education Integration

The rapid development of information technology (IT) has provided new opportunities for vocational education and industry-education integration. Ali highlighted how online learning, particularly driven by the COVID-19 pandemic, enhances teaching flexibility and efficiency by leveraging digital technologies [15]. Freina and Ott emphasized that immersive virtual reality in education bridges the gap between theoretical knowledge and practical skills through simulations [16].

In China, Yao and Yang discussed how information technology enhances the integration of vocational education with industry, facilitating dynamic adjustments and precise alignment with industry demands, strengthening practical training, and establishing an industry-education integration mechanism through school-enterprise cooperation. They also explored strategies for applying information technology in constructing models for vocational education and industry-education integration [17]. Similarly, Fu and Li argue that the digital transformation of vocational education fundamentally lies in utilizing digital technology to restructure the

learning spaces within the vocational education system, ensuring precise alignment and optimal compatibility with the goal of cultivating highly skilled talent [18].

3 Research Methods

This study utilized various research methods including literature review, textual analysis, and statistical analysis. Each method is discussed accordingly.

3.1 Literature Review

The current study performed a detailed literature review with in-depth analysis to fully comprehend the research background and theoretical foundations of industry-education integration in vocational education. We utilized various sources such as online searches and library resources to collect a wide range of relevant literature on domestic and international policies. The collected materials were then organized and analyzed systematically.

3.2 Textual Analysis Method

The PKU law and Lawinfochina are two of the most widely accepted databases in China, covering all policy documents, laws, and regulations within the country; therefore, policy texts were obtained from these sources. Additionally, this study integrated materials from official websites to ensure comprehensive coverage and to guarantee the accuracy and scientific rigor of the selected policy texts.

The study analyzed the policy discourse surrounding industry-education integration by first examining the patterns of policy issuance. The main objective was to review the evolution of policy changes and the practical directions of industry-education integration in vocational education. Initially, policies related to industry-education integration in vocational education were categorized into different stages, with representative and highly relevant policy texts identified for each stage. Irrelevant content was excluded, and following the principle of comprehensiveness, relevant sentences related to industry-education integration were extracted and compiled into a single document. This document was subsequently imported into ROST CM 6.0 to analyze Chinese policy texts and literature. ROST CM 6.0 is equipped with many features tailored specifically for Chinese social sciences and humanities research, such as specialized tools for policy text analysis, giving it an advantage over other general-purpose analysis software; thus, it allows precise processing of Chinese texts since it is designed specifically for the Chinese research context. A stop-word list was applied to filter out unnecessary terms, and the top 20 high-frequency keywords were selected. Through the word frequency analysis of these keywords, it was revealed that the policies shifted in focus over different periods. The impact of these changes on the direction of vocational education policies was then evaluated. The research framework of this study is shown in Fig. 1.

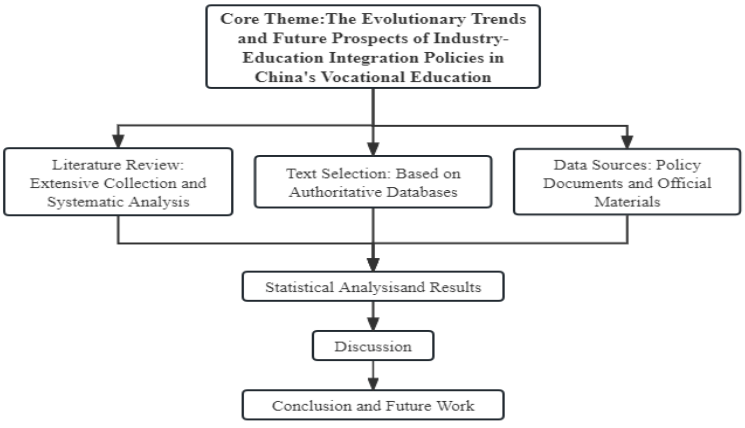

Fig. 1. Research framework diagram

4 Statistical Analysis and Results of the Study

This study divided the evolution of China's industry-education integration policies into four stages in chronological order: Rebuilding (1978-1995), Development and Consolidation (1996-2002), Exploration and Innovation (2003-2012), and Advancement and Deepening (2013-present). The specific basis for this division is explained in detail in the analysis of each stage, as shown in Fig. 2.

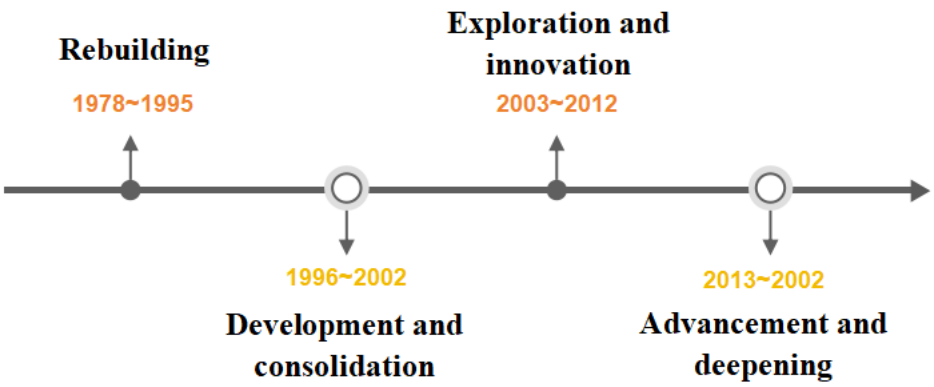

Fig. 2. Historical stages of the evolution of China's industry-education integration policies

4.1 Rebuilding and Initial Stage (1978-1995)

The long-term impact of the Cultural Revolution left many young people across various sectors of society without the necessary knowledge and skills to thrive in a changing economic and social environment and to assume significant responsibilities at work. As the reform and opening-up era began, economic growth emerged as the primary focus of China's socio-economic agenda. The initial phase of industry-education integration was characterized by efforts to revive vocational education and align it with social development.

In 1978, during the National Education Work Conference, Deng Xiaoping highlighted the significance of balanced development across various levels and forms of education, advocating for the establishment of more secondary vocational and technical schools. Nanjing Vocational University in 1980 marked a significant milestone—the birth of vocational universities and the reinstatement of junior college education. This year also signaled the gradual restoration of the national education system reforms.

In 1986, the "Regulations on the Work of Technical Schools", mandated that school-based teaching and production internships should closely mirror real-world enterprise production. The regulation emphasized the importance of developing students' practical skills and ability to address actual production challenges within enterprises. Additionally, it required school administrative departments to coordinate with relevant enterprises to facilitate students' production internships. This regulation was the first document to explicitly acknowledge the inseparable link between education and social production, promoting the educational philosophy of integrating teaching with practical production experience, marking the formal inception of the policy.

The key documents from this period include the "Implementation Opinions on the Outline of China's Education Reform and Development" (State Council, 1994). Sentences concerning industry-education integration in vocational education were extracted from these documents and were analyzed with ROST CM 6.0 for word frequency analysis. The analysis identified the top 20 high-frequency keywords which are presented in Table 1 and Fig. 3. It is evident that during the rebuilding and initial stage, the country placed significant emphasis on vocational education, reflecting a strong commitment to advancing reform, with industry-education integration emerging as a central focus of the policy. By aligning education with industry needs and promoting school-run enterprises, the link between the education system and market demands was strengthened. Policies started to emphasize school-enterprise collaboration and practical training, enhancing the connection between theory

and practice by establishing internship centers and promoting joint programs between schools and enterprises to develop students' hands-on skills. Simultaneously, policies during this stage actively explored various implementation practices, introducing measures for clear responsibility allocation, system construction, and workforce training. Although the policies were broad and general, they set the stage for future advancements.

In the context of the social environment, this period can be regarded as the phase of rebuilding and initiating industry-education integration. During the rebuilding and initial stage (1978-1995), vocational education policies primarily focused on restoring and expanding basic vocational education, emphasizing government-led initiatives aimed at providing foundational skills. Although information technology (IT) was not yet widely implemented in vocational education during this period, its foundations were already being laid. With the early development of computer technology in the 1980s, some vocational schools began to introduce basic computer courses into their curricula, providing students with essential computer operation and skills training [19]. These early initiatives set the stage for the broader adoption of IT in vocational education, enabling it to better meet the demands of the information age in later stages.

Table 1. Top 20 high-frequency keywords in the rebuilding and initial stage

No.	Keyword	Frequency	No.	Keyword	Frequency
1	School-run	5	12	Internship base	2
2	Industry-education integration	5	13	Pilot	1
3	Enterprise	5	14	Hosting	1
4	Development	4	15	Contact	1
5	Joint	2	16	Clarification	1
6	Establish	2	17	Improvement	1
7	Implementation	2	18	Advocacy	1
8	School	2	19	Educating	1
9	Vigorously	2	20	System	1
10	Vocational education	2	21	Worker	1
11	School-running	2			

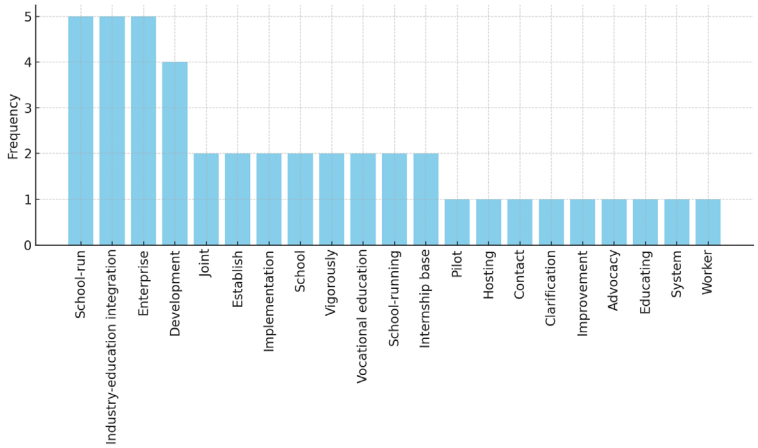

Fig. 3. Top 20 high-frequency keywords in the rebuilding and initial stage

4.2 Development and Consolidation Stage (1996-2002)

In 1996, the promulgation of the "Vocational Education Law of the People's Republic of China" established the legal framework for the industry-education integration for vocational training. This landmark legislation explicitly mandated the adoption of an industry-education integrated teaching model and endorsed the establishment of collaborative vocational schools by various social entities.

In 2002, the "Decision of the State Council on Vigorously Promoting the Reform and Development of Vocational Education" emphasized the vital role of industries and businesses in vocational education. The decision highlighted the necessity for enhanced cooperation among enterprises, industries, and vocational schools to establish a diversified educational framework. This framework was envisioned as being government-led, with active participation from enterprises and social forces, and aimed at maximizing the role of industry in vocational education. It advocated for various forms of collaborative education and outlined an organizational structure for industry-education integration. This structure encouraged coordinated efforts among the government, industries, schools, and enterprises. Following this decision, a series of policies promoting "industry-education integration" was introduced, which aided in the continuous advancement of vocational education and the refinement and strengthening of earlier policies.

Representative policy documents related to industry-education integration in vocational education from this period include the "Notice on Issuing the Principles of Deepening Vocational Education Teaching Reform Facing the 21st Century" (State Education Commission, 1998). Sentences on industry-education integration from these documents were extracted and a similar process as above was done. The top 20 high-frequency keywords were identified and are presented in Table 2 and Fig. 4. During this period, policies placed significant emphasis on fostering close cooperation between vocational education and the business sector, thereby enhancing the functions of vocational schools. The policies underscored the government's support for greater enterprise involvement in vocational education and the interaction between educators and industry professionals to ensure the effectiveness and relevance of the education being offered. They highlighted the critical role of integrating practical experience and occupational competencies into the curriculum through the involvement of part-time instructors and technical training by industry experts.

Furthermore, the policies of this period focused more on implementation practices that included improving teaching quality, regularly evaluating and adjusting curricula, and enhancing students' practical engagement with enterprises. The educational content was continuously refined to meet the evolving market and current technological demands. Compared to the previous period, the policies during this stage emphasized an even closer integration of vocational education with the business sector, highlighting the roles of teachers and industry experts. Consequently, these policies represent a crucial phase in the development and consolidation of vocational education. During this stage (1996-2002), vocational education policies placed greater emphasis on aligning education with market demands and fostering stronger industry-education collaboration. Information technology (IT) started to play a more significant role during this period as the Chinese government recognized its potential to enhance vocational education. The introduction of IT courses in vocational institutions became more widespread, and schools increasingly incorporated IT skills into their curricula to better prepare students for the growing digital economy [20]. This period marked the beginning of a more structured approach to integrating IT into vocational training, focusing on improving both the quality of education and students' employability in a technologically evolving labor market.

Table 2. Top 20 high-frequency keywords in the development and consolidation stage

No.	Keyword	Frequency	No.	Keyword	Frequency
1	Occupation	9	12	Excellent	3
2	Enterprise	9	13	Strengthen	3
3	Teacher	7	14	Development	2
4	Vocational Education	6	15	Teaching	2
5	Colleges	5	16	Acceptance	2
6	Participation	4	17	Regular	2
7	Part-time	3	18	Combination	2
8	Organization	3	19	Student	2
9	Technology	3	20	School	2
10	Expert	3	21	Course	2
11	Education	3			

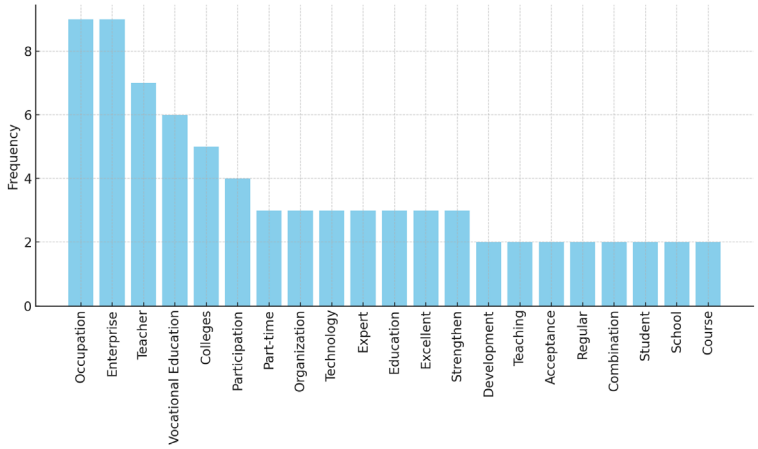

Fig. 4. Top 20 high-frequency keywords in the development and consolidation stage

4.3 Exploration and Innovation Stage (2003-2013)

In the early 21st century, as economic and social development gained momentum, the demand for highly skilled professionals grew, leading to a more diverse structure of industry-education integration. In response, the state actively explored various innovative policy paths. The Ministry of Education (2004) issued the "Opinions on Further Strengthening Vocational Education Work" which urged industries and enterprises to actively engage in the development and training of skilled professionals, creating a collaborative education model between industries and vocational schools. The issuance of this document marked a significant shift towards a diversified and innovative development of policies, advancing talent cultivation models and leading vocational education to a more structured, order-based training approach.

In 2011, the Ministry of Education released the "Opinions on Promoting Reform and Innovation in Higher Vocational Education to Lead the Scientific Development of Vocational Education". It encouraged higher vocational institutions to collaborate with the government and enterprises and explore the formation of vocational education groups. Issuance of this document marked a significant step toward exploring new practices, such as "vocational education groups" alongside the existing order-based training models.

During the exploration and innovation stage, numerous policy documents concerning industry-education integration were introduced. From these, eleven highly relevant policy texts were selected, including the "Opinions on Further Strengthening Vocational Education Work" (Ministry of Education, 2004). Sentences related to industry-education integration in vocational education from these eleven documents were extracted and analysis methods are the same as above. The top 20 high-frequency keywords were identified and are presented in Table 3 and Fig. 5. It can be seen that policies during this stage promoted closer cooperation, with a strong emphasis on improving and developing a vocational education system aligned with market demands. The term "dual-qualified teachers" appeared frequently, indicating the importance of professionals as educators with theoretical knowledge and practical experience. Policies encouraged the adoption of practice- and technology-oriented teaching methods to cultivate highly skilled talents who meet market needs, having dual certification in both academic and vocational qualifications.

Exploring "vocational education groups" and "order-based" training models prompted a search for new industry-education integration models. These innovative approaches were aimed at enhancing the integration of resources, improving educational efficiency, and directly responding to specific market needs. The measures showed that during this period, the government emphasized adaptability, flexibility, and better market orientation of vocational education. These initiatives, embedded in vocational education policies, demonstrated the government's deep concern for educational quality, innovative educational models, and the merging of education with industry, ensuring effective adaptation to the demands of economic development.

During the exploration and innovation stage (2003-2013), vocational education policies in China focused on developing innovative approaches to better align educational content with market demands. This period saw a significant push towards integrating IT into vocational education, driven by both technological advancements and

the need for a skilled workforce capable of operating in a rapidly digitizing economy. As shown in the keyword analysis for this stage, terms such as "technology", "development", and "practice" were predominant. Further, IT was incorporated both in the curriculum design and teaching methods, with vocational institutions embracing digital tools, such as online learning platforms, simulation software, and virtual laboratories, to enhance the practical and technical skills of students. This not only improved the quality of vocational training but also enabled students to gain hands-on experience with industry-standard technologies. Therefore, IT integration during this stage played a pivotal role in fostering a more technologically competent and adaptable workforce.

Table 3. Top 20 high-frequency keywords in the exploration and innovation stage

No.	Keyword	Frequency	No.	Keyword	Frequency
1	Enterprise	34	13	Improve	7
2	Vocational Schools	18	14	Order-based	6
3	Teacher	16	15	Cooperation	6
4	Establish	13	16	Occupation	6
5	Vocational Education	12	17	Practice	5
6	Vocational Colleges	11	18	Technology	5
7	Training	9	19	School-Enterprise Cooperation	5
8	Student	9	20	Part-time	4
9	Talent	8	21	Vocational Education Group	3
10	Development	8	22	Industry-Education Integration	3
11	System	8	23	Dual-Teacher	3
12	Positive	8	24	Dual-Certificate	3

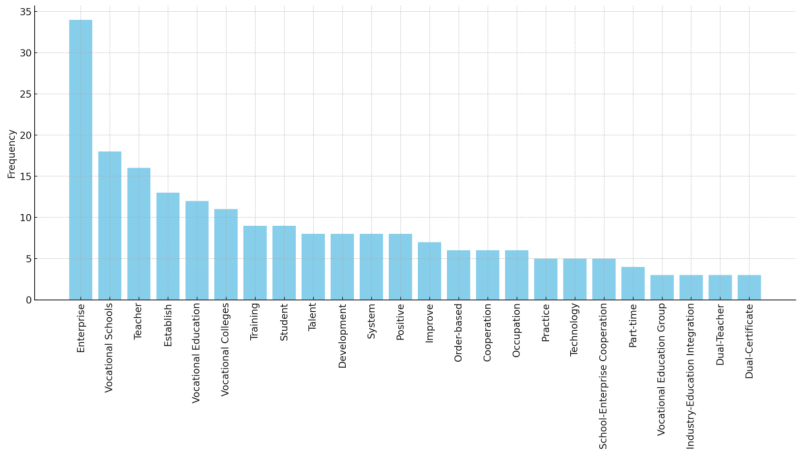

Fig. 5. Top 20 high-frequency keywords in the exploration and innovation stage

4.4 Advancement and Deepening Stage (2013 to Present)

In 2013, the Central Committee of the Communist Party of China issued the "Decision on Major Issues Concerning Comprehensively Deepening Reforms" which was the first time the term "industry-education integration" was used in place of "industry-education combination", signaling a shift in focus. It also integrated the advancement of industry-education synergy into the national strategy for economic and social progress.

In 2017, the General Office of the State Council issued the "Several Opinions on Deepening Industry-Education Integration", which elevated industry-education integration into a national strategy to foster a balanced economic and social development. This strategy was aimed at comprehensively enhancing education quality, expanding employment and entrepreneurship opportunities, facilitating economic transformation and upgrading, and cultivating new drivers of economic growth. Since then, industry-education integration has become a nation-

al concern serving as a cornerstone for education reform, economic development, and industrial advancement.

On 13th June 2023, the National Development and Reform Commission, the Ministry of Education, the People's Bank of China, and eight other departments jointly issued the "Implementation Plan for Empowering and Enhancing Industry-Education Integration in Vocational Education" (2023-2025), reiterating the significance of deepening industry-education integration and collaborative education. During this stage, industry-education integration was heavily promoted.

In the advancement and deepening stage, a substantial number of policy documents were introduced. Twelve highly relevant policy texts were selected for analysis, including the "Opinions on Conducting Pilot Work for Modern Apprenticeship" (Ministry of Education, 2014), and the "Implementation Plan for Empowering and Enhancing Industry-Education Integration in Vocational Education (2023-2025)" (National Development and Reform Commission, 2023). Through text analysis, the top 20 high-frequency keywords were identified and are presented in Table 4 and Fig. 6. It can be seen that enterprises became central to vocational education, having unprecedented collaboration between schools and businesses. A significant emphasis on aligning educational content with the actual needs of the industry can also be observed, resulting in policies that require educational institutions to develop new educational programs, build more advanced infrastructure, and develop innovative teaching methods and curriculum design. This includes sharing resources with enterprises and co-developing courses and training programs. Additionally, the policies stressed the importance of practical teaching and technology application in vocational education, encouraging the integration of real-world experience and modern technology into the educational process. Notably, multiple documents highlighted the "modern apprenticeship system" which prioritizes skill transmission through joint efforts between schools and enterprises in talent cultivation. This system involves establishing standardized enterprise course standards and assessment schemes, reflecting deep school-enterprise cooperation.

Additionally, this stage demonstrated greater cooperation between enterprises and educational institutions. Policy arrangements became more comprehensive and detailed, with a multitude of policies highlighting the integration of industry and education as well as cooperation between schools and businesses, aiming to build a more efficient and modern vocational education system aligned with market demands, technological advancements, and national strategies. Also, in the advancement and deepening stage (2013 to present), vocational education policies in China have begun to increasingly focus on integrating IT to enhance both the quality and relevance of education. As indicated by the keyword analysis for this stage, terms such as "enterprise", "innovation", and "technology" have become central to policy development. Moreover, IT has been extensively adopted in vocational education to create a more interactive and industry-relevant learning environment. For example, digital platforms, cloud computing, and big data have been integrated into the curriculum, enabling students to engage in real-time industry simulations and receive instant feedback on their performance [21]. This period has also seen the expansion of online vocational training and the development of modern apprenticeship programs that leverage digital tools to ensure continuous learning and skill development. The incorporation of IT not only bridges the gap between education and the evolving needs of industries but also ensures that students are equipped with the digital skills necessary for the modern workforce. These advancements underscore the role of IT in driving the evolution of vocational education and strengthening industry-education collaboration during this stage.

Table 4. Top 20 high-frequency keywords in the advancement and deepening stage

No.	Keyword	Frequency	No.	Keyword	Frequency
1	Enterprise	27	13	Base	5
2	Vocational Colleges	14	14	Innovation	5
3	Industry-Education Integration	12	15	Education	4
4	Development	12	16	Practice	4
5	Vocational Education	10	17	Encouragement	4
6	Participation	10	18	Mechanism	4
7	Construction	8	19	Teaching	4
8	Resources	8	20	Vigorously	3
9	Cooperation	8	21	Apprentice	3
10	Training	8	22	Region	3
11	Increase	6	23	System	3
12	Policy	5	24	Technology	3

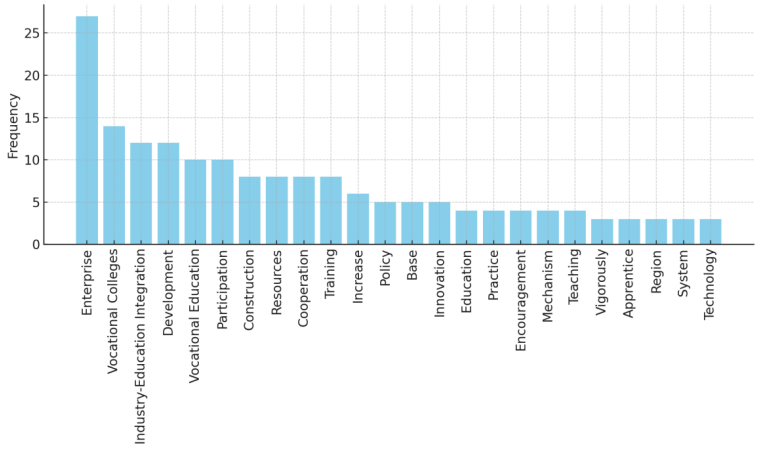

Fig. 6. Top 20 high-frequency keywords in the advancement and deepening stage

5 Discussion

This section summarizes the key patterns observed in the evolution of China's policies on industry-education integration based on the analysis performed on the four stages: Rebuilding (1978-1995), Development and Consolidation (1996-2002), Exploration and Innovation (2003-2012), and Advancement and Deepening (2013-present).

5.1 The Shift from Centralized Management to Market Orientation

In the early stages, vocational education policies in China were predominantly managed and controlled at the national level, with a strong emphasis on direct government guidance over the education system and uniform planning of educational content and structure. The primary goal of these policies was to restore and rebuild the vocational education system, with development largely dependent on government support and resource allocation, reflecting a centralized management model. Meanwhile, during the advancement and deepening stages, vocational education policies placed greater emphasis on market demand and enterprise participation. Rather than relying solely on direct government intervention, policies advocated for greater school-enterprise cooperation. Enterprises were encouraged to engage in curriculum design, internship arrangements, and skill certification which were aimed at aligning vocational education more closely with market needs to enhance the adaptability and flexibility of the education system. Additionally, policies started to promote investment from the private sector and other non-governmental entities, fostering diversification and optimizing the allocation of educational resources. This market-oriented shift was further supported by the growing recognition of the role of IT. IT integration started to be recognized as essential for facilitating collaboration between enterprises and educational institutions, improving communication, and enabling real-time adjustments to curricula based on industry needs. This marked a significant step forward in ensuring that vocational education could keep pace with technological advancements and industry demands.

Vocational education policies transitioned from a predominantly government-led model to a more market-oriented and diversified participation model during the later stage. The results of the analysis reflected the gradual maturation of China's vocational education policies, and their ability to respond and adapt to changes in the external environment. By incorporating market mechanisms and encouraging diverse participation, vocational education was able to effectively meet economic development needs, enhance the allocation of educational resources, and elevate the standard of talent cultivation.

5.2 Continuous Innovation and Practical Application of Educational Content and Methods

In the rebuilding and initial stages, policies were focused on restoring vocational education with an emphasis on providing basic skills and knowledge to students. Educational content was centered on traditional crafts and technical operations, with teaching methods primarily involving theoretical instruction and basic skills training. As the economy developed and market demands evolved, vocational education began to align more closely with practical needs and market requirements. Policies started to support and encourage vocational schools to collaborate with enterprises to better understand market demands and integrate them into educational content and curriculum design. Consequently, the focus shifted towards developing students' practical skills and enhancing connections with real work environments through internships and practical training.

In the advancement and deepening stages, vocational education policies started to prioritize innovation and practical application in educational content and methods. Technological advancements and shifts in economic structures required continual updates to teaching content to align with emerging industry technologies and market demands. Teaching methods evolved from traditional classroom lectures to more interactive, project-oriented, and problem-based learning approaches, designed to enhance students' critical thinking and innovation capabilities. During this period, the integration of IT became a critical factor in driving innovation within vocational education. Digital platforms, simulation tools, and online learning resources allowed for more flexible and interactive learning experiences, enabling students to develop both practical and technical skills in a dynamic environment. IT also facilitated the inclusion of industry-standard technologies in the curriculum, ensuring that students were trained on the tools and software currently in use in the workforce.

Overall, these changes reflected the government's strong resolve to push for innovation and practical application in vocational education by implementing policies that align with the demands of national economic and social progress. The shift in focus from providing basic skills education to incorporating market-relevant skills and enhancing technological integration underscores a commitment to improving the effectiveness and standard of vocational education. Moreover, this transformation ensured that the education system could better adapt to the rapidly changing economic and technological landscape. Through these advancements, highly skilled and innovative talents capable of meeting future labor market demands are cultivated, thereby supporting the nation's long-term growth and enhancing international competitiveness.

5.3 The Shift in Policy Focus: From Expanding Access to Enhancing Quality and Efficiency in Vocational Education

The early stages of China's vocational education policies primarily focused on restoring and expanding vocational education to address the high demand for skilled workers due to rapid industrialization and economic development. Policies emphasized intensifying the reach of vocational education by establishing more vocational schools and technical colleges that offer various training programs. The educational content mainly provided students with basic skills and knowledge to ensure that essential vocational competencies are acquired.

As the economy developed and labor market dynamics changed, policies evolved from mere expansion to enhancing the quality and effectiveness of education. During the mid-stage, policies began to emphasize innovation in educational content and methods to better align with economic structural transformations and the needs of emerging industries. This included strengthening cooperation with enterprises, introducing market-oriented curriculum designs, and enhancing the integration of education with actual work environments. Additionally, educational outcomes were improved by implementing new assessment standards and quality monitoring mechanisms to ensure that educational quality met industry standards and market demands. With the rise of IT during this period, vocational education began incorporating digital tools to improve the efficiency and quality of education. Online platforms and IT-based monitoring systems allowed for better management of educational resources and provided students with more access to quality learning materials.

In the advancement and deepening stages, vocational education policies increasingly focused on improving educational quality and efficiency. Key policy measures included promoting a deeper industry-education integration, encouraging innovative teaching methods such as project-based and practical learning, and enhancing teacher training and professional development. Additionally, continuous updating of educational content was prioritized to keep pace with technological advancements and market changes, while improving the overall efficiency of the education system through more effective management and operational mechanisms. The integration of IT during this stage further strengthened these efforts by facilitating online learning, virtual apprenticeships, and data-driven teaching methodologies. This allowed for real-time updates to curricula based on industry trends

and improved student engagement through interactive learning experiences. IT became a critical enabler of the vocational education system's shift to quality and efficiency improvement from focusing solely on quantitative expansion.

As observed from the policy evolution process, China's vocational education policies have adapted to address the demands of national social development. The gradual shift allowed the country to meet changing labor market demands and demonstrated the government's ability to proactively plan for future technological and economic trends. By enhancing the quality and efficiency of education, the policies cultivated a more innovative and flexible workforce that supports the nation's economic transformation and sustainable growth. This transition marks a significant turning point from quantitative expansion to qualitative enhancement in vocational education, ensuring that it meets current market needs while anticipating and adapting to future challenges. The continued integration of IT plays a vital role in this process, enabling vocational education to remain responsive to both technological advancements and market requirements.

6 Conclusion and Future Work

This study provides a thorough examination of the progress that China has made in industry-education integration policies within vocational education. The ROST CM 6.0 was used for word frequency analysis of key policy documents which revealed a clear progression during the four stages of evolution namely, the initial rebuilding stage, the development and consolidation stage, the exploration and innovation stage, and the advancement and deepening stage.

In the rebuilding stage, policies were focused on restoring and expanding basic vocational education aimed at foundational skill transmission. As the economy and labor market evolved, China entered the development and consolidation stage which highlighted market adaptability and practical integration, with the initial concepts of school-business collaboration and industry-education alignment becoming more prominent. The exploration and innovation stage marked a significant shift towards innovative educational methods and content, highlighting the need for closer alignment with market demands and technological advancements. This period saw increased diversification in teaching methods and workforce development, along with the early integration of IT into vocational education. Finally, in the advancement and deepening stage, a concentrated effort to enhance educational quality and efficiency was observed, with a deeper industry-education integration, a stronger market orientation, and the widespread incorporation of IT and technical skills into the curriculum.

Overall, the progression of China's policies on vocational education reflects a transition from centralized management to a more market-oriented approach, emphasizing continuous innovation and practical application of educational content and methods. The shift from expansion to quality improvement underscores the importance of vocational education policies to remain adaptive and responsive to changing economic and technological contexts. The increasing role of IT has been pivotal in ensuring that vocational education is constantly aligned with industry demands, as it provides the tools necessary for real-time adjustments in curriculum design and teaching methods.

To ensure that vocational education is supportive of the market and industry needs, we suggest that policymakers focus on sustaining and promoting school-business collaboration, industry-education alignment, and the continued integration of IT. Strengthening the role of enterprises in curriculum design, internship arrangements, and skill certification, while incorporating IT-driven platforms and tools, could enhance graduates' employability and vocational skills. Further, encouraging innovation in educational content and approaches, including project-based learning, simulated practices, and online education platforms could promote students' practical skills, technological proficiency, and innovative thinking. Regular updates to curriculum content to reflect technological trends and industry demands are essential to maintaining relevance. Additionally, enhancing educational quality and efficiency through refined monitoring systems, data-driven resource allocation, and digital tools will improve the operational effectiveness of the vocational education system. Continued government support through policy incentives, financial subsidies, and guidance will foster greater enterprise and private sector involvement in vocational education, particularly in IT-related fields. It is also suggested that establishing incentive mechanisms for innovation in education and maintaining flexibility to adapt to future labor market demands could be done to prepare the vocational education system for future economic and technological changes.

In summary, the measures mentioned above, especially the integration of IT, could ensure that China's vocational education system remains consistent with market demands, effectively supports national economic development and social progress, and provides students with valuable, technology-driven, and practical education.

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