

ORIGINAL ARTICLE

Exploring the path for vocational teacher training in China's high-quality development era: Based on Germany's practice

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ABSTRACT

Nowadays, vocational education in China is in a high-quality development phase, where the teaching staff is a core element in supporting the construction of a high-quality vocational education system. This period of high-quality development has led to higher requirements for the development of vocational education teachers. However, analysis using methods such as literature review and historical research reveals that there are still issues in the professional development of China's vocational education teaching staff, including outdated professional standards, insufficient training systems, and inadequate evaluation and incentive mechanisms. Over the last 100 years, Germany's vocational teacher training system has undergone a remarkable evolution from a less organized, rather brief program to a highly professionalized system that is still evolving in terms of teaching skills and linkage to the labor market. This paper analyzes the effective practices in German vocational education teacher training from the areas of vocational access standards, training systems, evaluation and incentive mechanisms, and digital literacy standards. Furthermore, suggestions are provided for cultivating a high-quality and professional vocational education teacher workforce in China, including developing laws and regulations, entry and qualification systems, integrated training systems, and digital transformation.

Key words: vocational education, teacher training, German dual system

INTRODUCTION


In 2017, the concept of "high-quality development" was first proposed at the 19th National Congress of the Communist Party of China. "High-quality development" refers to an economic development process that not only pursues growth in speed and scale but also emphasizes the quality and efficiency of development, highlighting the optimization and upgrading of the economic structure, as well as the transformation of the development model. The introduction of the high-quality development concept signifies that China's economy has shifted from a stage of high-speed growth

to a stage of high-quality development. Being the type of education most closely linked to economic and social development, vocational education bears the significant responsibility of cultivating skilled technical talents. The quality of skill supply and technical services directly impacts economic development (Wang & Xu, 2024). The report "Opinions on Promoting the High-Quality Development of Modern Vocational Education" from the Chinese Government in October 2021 indicates that to advance the high-quality development of modern vocational education, it is essential to continue implementing the plan to enhance the quality of teachers in vocational colleges and universities. Building a high-

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quality teaching force is crucial to achieving sustainable vocational education. The general secretary emphasized that strengthening the teacher workforce is fundamental to building a solid education system in China. He advocates for a distinctive teacher education system to cultivate a team of professional teachers with solid ethics, expertise, reasonable structure, and vitality. The training and development of vocational education teachers directly affect the quality of skilled personnel training and the sustainable development of vocational education (Shi, 2011). In 2024, Germany's academic section for vocational and business education celebrated its 50th Annual Conference at the TU Dresden. In the same year, the local TU Dresden Institute for Vocational Education and Vocational Didactics invited participants to a lecture series to commemorate the 100th anniversary of its foundation in 1924 (TU Dresden, 2024). Vocational teacher training has experienced a long-standing tradition in Germany as a field of higher education studies (Dieter, 2020). However, its development can be seen as an evolution from rather brief and less organized approaches to vocational teacher training to highly specialized programs alongside the different vocations. Over 100 years, a relatively scientific and comprehensive training system for vocational teachers has been established, combining experience from research with insights from industry. However, it is important to state that in the process of qualifying the future workforce in Germany, the vocational teachers are one of the two important major pillars (*i.e.*, responsible for 50% of the vocational education and training [VET]). The other major component of the dual system is the company-based qualification, which is mainly provided by the experienced workforce and the vocational instructors in the company. This theoretical construction and practical experience shall be considered as a reference that may have certain significance for understanding the development of vocational teachers in China in the high-quality development era.

DEVELOPMENT OF VOCATIONAL EDUCATION TEACHER TRAINING IN CHINA'S HIGH-QUALITY DEVELOPMENT ERA

The high-quality development of vocational education depends on both internal factors and external support, with a high-quality teaching force serving as the most crucial internal element. China's efforts to establish a unique vocational education teacher training model have undergone two significant phases: initially relying on general universities to support vocational education teacher training, followed by establishing independent vocational education teacher colleges. These two phases have significantly reduced the demand-supply gap for

vocational education teachers and enhanced their professional and theoretical capabilities (Cai, 2011). At the beginning of the 21st century, research and policy related to vocational education teacher training began to adopt Germany's dual system model, emphasizing the development of dual-qualified teachers. Various models of vocational education teacher training have been explored, such as building vocational training centers, promoting integration between industry and education, developing the "4 + 2" model, initiating the "Bachelors + Technician" and "School-Enterprise-School Alliance" model, and implementing high-level training such as master's and doctoral programs. Diversified training models have provided rich theoretical and practical support for the development of China's vocational teacher training system. After over 40 years of reform and exploration, China's vocational education teacher workforce has gradually moved from disorder to stable development. In terms of the formation of concepts and ideas, the establishment of systems and characteristics, integrated training, and the enhancement of professional quality, a path for constructing a vocational education teacher training system with Chinese characteristics has been gradually explored.

High-quality vocational education requires an even higher quality of teachers. In the new era, vocational education teachers should possess a strong theoretical background, noble ethical qualities, good mental health, and digital literacy for the artificial intelligence (AI) era. A well-built training system for vocational teachers is an important guarantee for the construction of a high-quality teacher's team. Nowadays, the growth of the vocational education teacher workforce has been relatively slow. According to statistics, the proportion of dual-qualified teachers has exceeded 55%, reaching the target set in the "Plan for Deepening the Reform of the Vocational Education Teacher Workforce" by 2022 (Ministry of Education and other four departments, 2019). However, the lack of dual-qualified teachers who possess both theoretical knowledge and practical teaching skills is an important issue that cannot be ignored (Ministry of Education, 2003). Despite meeting this numerical target, significant gaps in quality remain, as the teaching standards fall short of the high-quality development goals of vocational education. The vocational teacher workforce is in a state of imbalance between quantity and quality.

Outdated professional standards for vocational education teachers

The professional development of vocational education teachers is essential for the high-quality advancement of vocational education and the sustainable growth of the teachers themselves. Due to the distinct nature of vocational education, vocational education teachers must

possess a mix of "academic, technical, and pedagogical" skills and strong adaptability to various roles (Du & Wu, 2020). This necessitates strict requirements for professional standards and entry thresholds for vocational education teachers. Currently, vocational schools in China lack standardized entry procedures, resulting in inconsistent teacher quality (Tang & Shi, 2012). According to the National Vocational School Teacher Survey Report, 54.2% of secondary vocational education teachers and 48.4% of higher vocational education teachers do not have any work experience related to the subjects they teach (Chen & Feng, 2024). This situation primarily arises because many vocational education teachers are recent graduates who lack the necessary industry experience and have little pedagogical training. While these teachers may fulfill theoretical knowledge requirements, their skills in practical training often fall short of real-world demands (Ren, 2023). Given the complex professional backgrounds in vocational schools, teacher standards must be targeted more. Presently, existing professional standards only apply to secondary vocational education teachers, lacking criteria for higher vocational education teacher's qualifications and professional title assessments. Additionally, the lack of a clear certification system leads to insufficient scientific and long-term planning for cultivating and training higher vocational education teachers (Shao & Xu, 2016).

Inadequate training systems for vocational education teachers

To align with industry trends and talent development needs, vocational education teacher training must involve three systematic processes: professional knowledge acquisition, practical experience, and specialized teacher training. However, a significant gap exists between the current training system and vocational education teachers' professional development needs, which fails to equip future teachers with essential skills (Liu & Sang, 2024). First, vocational education teacher training content is overly theoretical and conceptual, lacking practicality and operability, making it difficult for teachers to master necessary technical skills effectively (Zong, 2023). Second, the absence of dedicated institutions for pre-service teacher training in higher vocational education leads to various weaknesses in educational skills, practical skills, and professional knowledge structure (Shao & Xu, 2016). Third, vocational schools do not prioritize post-service teacher training, resulting in insufficient training programs. Currently, post-service training is mainly lecture-based, lacking specialized, cutting-edge, and practical courses, which contradicts the advocated "learning by doing" teaching philosophy and fails to provide concrete work-based learning models (Xu, 2016). Moreover, digital literacy training programs fail to consider the character-

istics of vocational education and the professional growth of teachers, making them inadequate in meeting diverse and individualized teacher needs (Wang *et al.*, 2023). This lack of targeted training reduces learning motivation, leading to low utilization of digital teaching resources (Ding *et al.*, 2024). In pre-service or in-service training, the vocational education teacher training system remains insufficiently comprehensive, failing to provide individualized training based on teachers' needs. This results in low resource utilization and limited professional growth among teachers.

Unscientific evaluation and incentive systems for vocational education teachers

The evaluation, promotion, social status, and compensation of vocational education teachers significantly impact the profession's attractiveness and the overall quality of the vocational education teacher workforce (Zhang, 2018). Evaluation outcomes serve as measures of teaching quality, while positive and negative incentives act as catalysts for teacher improvement. However, the current evaluation system for vocational education teachers is outdated, with a singular evaluation approach focusing more on outcomes than processes (Zhou, 2014). The evaluation criteria for teachers primarily emphasize the quantity and quality of published papers and research projects rather than teaching effectiveness (Xie, 2015). A unified evaluation metric is applied across different disciplines, ignoring the distinct characteristics of various specialties, which diminishes the value of evaluations, delays the impact of incentives, and reduces teachers' motivation for self-improvement (Chen *et al.*, 2020).

The conflict between cultivating high-quality skilled personnel and developing a high-quality vocational education teacher workforce in China urgently requires further resolution to meet the demand for highly qualified talent during the current social transformation period.

OVERVIEW OF TEACHER TRAINING IN GERMAN VOCATIONAL EDUCATION

In the development of vocational education and its corresponding teacher training, Germany, based on the characteristics of its national vocational education personnel training and through a series of improvement and development processes, gradually constructed a talent and teacher training model that meets the development of its industry and the needs of its enterprises.

The leading teacher training practices in vocational education in Germany

According to the Federal Republic of Germany's

Vocational Education Act, vocational education in Germany is divided into two systems: school education and non-school education. The German dual system model of vocational education belongs to the primary vocational education stage of the vocational school education system. The so-called "dual system" refers to a mode of training in which enterprises recognized by the qualification standards of the Federal Act on Vocational Education and vocational schools work together to train students. Under the dual system, students receive vocationally relevant specialized theoretical and general cultural education knowledge. On the other hand, they undergo on-site training on the theoretical knowledge acquired at the enterprise. The school and the enterprise fulfill their respective roles as two different study places (Bourichter et al., 2009). The dual system's goal is rooted in local industrial roots and philosophical concepts, contributing to a social concept emphasizing vocational education in Germany (Li, 2024).

The development process of dual-system vocational education has resulted in the formation of "dual" vocational education teachers, which is mainly reflected in the duality of teacher structure and the duality of teacher quality. First, the dual teacher structure refers to the vocational school teachers and enterprise trainers. Vocational school teachers undergo theoretical teaching according to the teaching plan to cultivate students' systematic theoretical knowledge and ability; corporate trainers train according to the training program to develop students' practical ability. In the dual system model, both vocational teachers and corporate trainers complete the teaching task in their respective roles and jointly. Second, the quality of teachers is dual, and both vocational school teachers and corporate trainers must meet the requirements of teaching knowledge, methods, and ability. Regarding qualifications, vocational school teachers should have a solid theoretical foundation and skillful practical skills: First, a certain degree to ensure that the teachers have a profound basic theoretical knowledge; second, mastery of vocational education teaching ability, vocational education teacher education, and completion of the required period of educational internship; third, a certain degree of vocational practical experience and the relevant professional work experience. Corporate trainers are excellent employees, engineers, or senior technicians from the enterprises, and they need to have more than three years of professional practical experience. In terms of education, the trainer should also have completed a specific type of vocational education and obtained a vocational qualification certificate, received vocational training in the same professional direction, and passed the corresponding exams (such as exams organized by industry associations) to obtain the training qualification certificate. At the same time, corporate trainers must

master the ways and means of vocational education and teaching and have specific educational and learning capabilities to be competent in the practical teaching of young students (Xie, 2019). Teacher training in vocational education in Germany places great emphasis on academic education, practical skills, educational technology, professionalism, and interdisciplinary competence (Table 1; Chu, 2016; Dieter, 2020; Tang & Wei, 2023; Xu & Zhou, 2024).

In addition to the traditional training mode of "national examination for VET teachers", some universities in Germany have innovatively developed a new mode of "Master of Vocational Education", which abolishes the first national examination system, and graduating with a master's degree equals passing the first national examination (Wang & Cao, 2024). Germany has established a lifelong teacher training system through an integrated approach to teacher development, from pre-service training paths tailored to different specialties to in-service professional development that occurs every two years (Wu & Wang, 2023). With strict entry standards, diverse training content, and advanced academic training levels, the quality of vocational teacher education is ensured, providing strong support for the cultivation of high-quality personnel.

Advantages and excellent practice of teacher training in vocational education in Germany

Rigorous entry requirements for the teaching profession

Vocational education teachers in Germany are expected to excel in both theoretical and practical teaching abilities. To achieve this, they must have strong theoretical teaching skills and substantial practical experience. Therefore, Germany has set strict entry standards for vocational education teachers to ensure high quality from the outset. These standards are closely aligned with the teachers' education and work experience, as mandated by the National Normative Framework for the Training and Assessment of Professional Teachers in Vocational Schools. Additionally, the framework accounts for variations in competencies across different professional fields, providing clear standards and legal requirements to regulate entry into the teaching profession (Tang, 2016).

Integrated career development and training system

Germany's vocational education teacher training system is essential for maintaining a high-quality teaching workforce. Pre-service education develops the professional and teaching skills necessary for future educators, while in-service training addresses the need for individualized professional development and lifelong learning.

Germany's vocational education teacher training system

Table 1: Traditional model of "national examination" for VET teacher training in Germany

Role	Training stage	Location	Duration	Course	Qualification certificates	Note
Vocational school teachers	Higher education stage	Higher Education prior to employment	Under-graduate level: 9 semesters	General culture courses, education courses, and vocational technical courses	Initial national exam, passing leads to appropriate degree and teacher qualification certificate	"double certification" is the basic requirement for entry into the next training stage
	Pre-employment preparation stage	Education colleges	2 years of dual system study	Study of vocational education pedagogy and practical training for teachers	Participate in the second national exam to obtain the teacher qualification certificate and pass practical assessments	Obtain vocational teacher appointment qualifications
	Continuing education stage	On-campus or off-campus training	5 working days per year	Knowledge and skills updates, understanding latest industry developments	Completion of training results in a certificate of continuing education	Government covers costs, certificate of continuing education serves as one of the criteria for promotion
Enterprise trainers	Vocational stage	Nationally recognized vocational education	2.5-3.0 years	-	Pass organizational exams and obtain vocational qualification certificate	-
	Trainer education stage	Mentoring/training/teaching	2 years full-time or 4 years part-time	Vocational education, legal regulations, curriculum design, practical assessments, <i>etc.</i>	Participate in the trainer exam, pass to obtain professional trainer certificate	Subsequent stages require 3-5 years of practical work experience
	Advanced studies stage	Advanced classes, seminars	-	Improve self-education - management, talent management, new product development	-	Costs covered by company or partially subsidized

VET, vocational education and training.

is divided into three interconnected stages, forming a coherent, integrated, and personalized approach to teacher development. Pre-service education represents the primary training phase and is governed by strict, standardized procedures. Post-service training is characterized by its flexibility and practical focus. Continuing education is a mandatory requirement for vocational education teachers in accordance with the Federal Vocational Education Act or the Teacher Education Acts. Teachers may attend paid professional development programs at both public and private institutions (Wu, 2011). By combining further training in enterprises and schools, vocational education teachers can stay current with industry trends and enhance their professional knowledge and teaching abilities to meet the demands of the industry and the development of society.

Digital technology empowers teachers to enhance professionalism

The widespread adoption of digital technology in teaching and practice has led nations to recognize the significance of digital skills innovation and to explore digital development strategies aligned with national growth. Teachers play a vital role in the application and dissemination of digital technology in schools, with increasing demands on their digital literacy and

proficiency in innovative technologies. However, some studies question the type of teaching behavior—from teaching to mentoring and tutoring (Köhler & Kahnwald, 2005; Riedel *et al.*, 2020). In addition, authors asked in their research whether a teacher is still needed. After the release of the Artificial Intelligence Strategy (Strategie Künstliche Intelligenz der Bundesregierung) in 2018, Germany has implemented a series of measures to promote the development of digitalization in the field of education, such as increasing the development of AI degree programs and talent cultivation, promoting industry-academia-research cooperation and the transformation of achievements in the field of AI, increasing financial support for and investment in AI, and strengthening international scientific research cooperation in AI (Chen, 2021).

In 2024, Germany introduced the Artificial Intelligence Action Plan and issued action recommendations for the use of AI in schools. These action recommendations provide a comprehensive explanation of core issues such as the impact of AI on learning and didactics, transformation of the examination system, professionalization of teachers, the construction of legal and regulatory frameworks, and the promotion of equal opportunities. The action recommendations offer a guiding framework for the practical application of AI in

the field of education and reflect a consensus among the states on how to effectively respond to the application of AI in school education (Bildungs-MK, 2024).

First, Germany has established professional standards for teachers' digital competencies, which serve as a foundation for teacher training programs. These standards clarify the expectations for teachers' digital literacy, and the country has released guidelines specifically targeting the digital skills of vocational education teachers. In addition, a framework of digital competence standards for teachers has been developed, outlining a professional development path for educators in the digital age. This framework is structured around six key competency areas: searching, processing, and storing information; communication and collaboration; problem-solving and action; production and presentation; protection and safe action; and analysis and reflection. These areas aim to foster independent learning, maturity, identity-building, and autonomous participation in the digital society. The framework also emphasizes the interconnectedness of digital skills within specific disciplinary contexts, integrating core literacy requirements across various academic disciplines in the digital world (Wu & Wang, 2023). The publication of this framework has better planned the professional development path for teachers in the digital era.

Second, Germany has enhanced its digital training system for teachers, focusing on improving their ability to utilize digital tools effectively. A curriculum supporting teachers' digital literacy has been established, incorporating digital skills training into pedagogy and professional courses for teacher trainees. To ensure balanced development across federal states and comparability of university teacher education programs, the federal government has introduced a catalog of evaluation criteria. This catalog outlines the key aspects of digital transformation in university teaching, such as learning objectives, scientific integration, and the use of digital media and organizational forms. It also highlights best practices in the digital transformation of teacher education, helping to standardize and enhance digital strategies across the federal states. Moreover, the German government has increased funding for digital teacher training and offers regular refresher courses that integrate digital technology into education and teaching. For example, the German Ministry of Economics, Labor, and Housing in Baden-Württemberg has established smart learning factories in vocational schools to help teachers use digital facilities in real work environments. These approaches promote the development of teachers' digital competencies (Lernfabrik 4.0., 2024).

A well-developed quality evaluation and incentive system

A robust evaluation system is central to assessing the

quality of teachers' work and achieving teaching objectives, while an effective incentive system provides feedback on teacher performance and encourages further professional development. The integration of sound evaluation and incentive mechanisms creates a sustainable loop of educational activities. Vocational education teachers in Germany obtain better social welfare and higher social status, which helps attract more individuals to the profession and alleviates the shortage of teachers to a certain extent.

Germany has established a quality evaluation system for teacher training that aims at professional development, employs total quality management as a means, and emphasizes collaborative cooperation. This system comprehensively constructs quality indicators for the development of vocational teachers from aspects including legal regulations and policies for teacher training, resource investment, training objectives and tasks, quality standards for training, responsibilities of training institutions, qualification examinations, and capability assessments (Shen & Zhou, 2016). In conjunction with this framework, the government has successfully incentivized the development and improvement of VET teachers. To encourage the growth of VET teachers, a specialized management team has been set up to monitor and evaluate the effectiveness of teacher training in terms of comprehensiveness, staffing, and process. An appraisal is conducted every two years, and qualified teachers are eligible for promotion. At the same time, Germany provides financial incentives to ensure stable workplace learning opportunities for vocational teacher trainees. For instance, Germany offers financial subsidies to companies that have been impacted by the coronavirus disease 2019 (COVID-19) crisis yet have managed to maintain a stable number of apprentices, with a subsidy of €2000 for each apprenticeship contract. For insolvent companies that still take on apprentices for training, the subsidy amount is €3000 (Yu & Bo, 2021).

CONCLUSION

In the context of the digital era, China urgently needs to strengthen its vocational education teacher training system. Drawing on Germany's successful experience, China can develop a feasible approach that aligns with local conditions to support high-quality development. This approach would cater to the demand for new types of technical talent and address the urgent need for high-level technical and skilled personnel in the current stage of China's high-quality development.

Strengthening the top-level design of laws related to vocational education teachers

Establishing and improving the legal status of vocational

education teachers is essential for building a high-quality teaching workforce. It is also key to elevating the social status of vocational education teachers. In developed countries, laws and regulations on vocational education are often detailed and comprehensive, covering everything from teacher training to school-enterprise cooperation. This specialization promotes the sustainable development of vocational education teachers. However, China's current laws related to vocational education teachers lack systematic normative guidance and a robust legal framework. Therefore, China should focus on top-level legislative design, clearly defining teachers' rights and responsibilities, ensuring legal protections, and enhancing legal support for the development of vocational education teachers. This will impact not only the professional growth of vocational education teachers but also the profession's attractiveness to the public.

Strictly regulating the admission system and criteria for vocational education teacher qualifications

China faces the significant challenge of building a team of highly qualified and specialized vocational education teachers. An effective teacher training system must combine teacher education with the process of obtaining teaching qualifications (Xu, 2016). As the main force in cultivating the nation's high-tech and skilled personnel, vocational education teachers must be professionally certified in their competency levels. Therefore, the state should establish unified professional standards for vocational education teachers' competencies and rigorous guidelines for obtaining qualification certificates. Lagging qualification standards often lead to the neglect of teacher development. The process of obtaining vocational education teacher qualifications should not rely on a one-time assessment. China can learn from international experiences by emphasizing teacher training and setting restrictions that ensure teachers are fully prepared before obtaining certification. This includes raising the qualification thresholds and creating differentiated standards for teachers in various professional fields, which would eliminate the current practice of "entering the profession first and certifying later". Furthermore, the "lifelong system" of qualification certificates should be abolished, requiring periodic reviews and renewals to stimulate teachers' professional development.

Improving the VET teacher training system and linking career development

Building a high-quality teaching force capable of meeting the demands of the modern era requires a standardized and systematic teacher training system. This system is vital for ensuring a steady flow of qualified teachers and supporting their professional development. Currently,

vocational education training in China is primarily conducted through projects issued by the education administration department. The project-based training system has continuously developed the professional development of vocational education teachers, but there are also some constraining problems. First, developing teachers' abilities requires long-term systematic cultivation, which a few lectures and training cannot improve. While the project-based system has contributed to the professional development of vocational education teachers, several limitations remain. First, the development of teachers' abilities requires long-term, systematic cultivation, which cannot be achieved through short-term lectures and training. Second, project-based training does not guarantee that all teachers receive the same training, leading to uneven resource distribution. Finally, compared to school-based programs, project-based courses often lack systematic implementation and institutional support. Given the international experience in solving this kind of problem, China should undertake a unified national plan to provide long-term, consistent training before and after teachers enter the profession. Systematic training courses should be organized to address the temporary and fragmented nature of the current system, ensuring that the courses are standardized, comprehensive, and tailored to meet the basic needs of teachers in education and teaching, the formation of teachers' education and teaching, and the development of a systematic training program (Liu & Sang, 2024). A pre-vocational and post-vocational integrated training system would foster the sustainable development of a high-quality vocational education teacher team.

Accelerating digital transformation in hardware and software and enhancing teachers' digital literacy

The rapid development of AI has significantly accelerated changes in knowledge structure, the pace of knowledge updates, and technological iterations, requiring vocational education teachers to continually expand their professional skills. The advancements in digital technology have broadened teachers' instructional scope, enabling pedagogical methods and tools to better integrate emerging technologies. Consequently, vocational education teachers need to continuously build digital competencies, including theoretical knowledge, practical skills, and technical proficiency, to effectively navigate the digital transformation within their field. However, in China, vocational education lacks standardized digital skills certification and a comprehensive digital skills training system. Thus, establishing clear and robust digital certification standards, enhancing the digital skills training framework, and building a supportive digital teaching resource platform are all essential for supporting teachers' professional

development. First, relevant policies and reference standards for digital literacy should be refined to guide teachers in addressing their digital literacy gaps systematically, ultimately enhancing their overall digital proficiency. Second, government bodies should allocate increased funding for digital transformation initiatives and for the necessary hardware and software upgrades, thus providing foundational support for teachers' digital skills acquisition. Furthermore, schools, government agencies, and other stakeholders should collaborate to integrate educational resources, creating digital lifelong learning platforms to address the unique learning needs of vocational education teachers across various specialties. Finally, digital literacy assessment tools are vital for helping teachers accurately evaluate their skill levels. Developing such tools, aligned with established digital literacy standards, will further elevate teachers' digital competencies (Yan & Liu, 2022). Additionally, schools should not only provide teachers with ongoing training in AI literacy but also offer practical teaching reform opportunities, giving teachers valuable experience in applying these technologies in classroom settings. Practical applications in this area can be further explored, such as leveraging the cross-regional nature of digital platforms to enhance international teacher exchanges and cooperation, thereby promoting the digital transformation of teachers' careers. Additionally, policies aimed at encouraging teachers to integrate AI technology into their teaching practices and fostering a digital culture can effectively cultivate teachers' digital literacy and teaching competencies in vocational colleges and universities.

Improving the evaluation system and incentive mechanism for vocational education teachers and stimulating internal motivation for teacher development

Teacher remuneration is, to some extent, a reflection of institutional recognition of teachers' contributions. Improving the salary incentive system and linking evaluation outcomes to compensation can raise teachers' living standards and simultaneously enhance their motivation to perform better. To achieve this, more targeted performance evaluation standards must be established (Xie, 2015). Vocational schools should develop a diversified evaluation system tailored to their unique characteristics, with differentiated evaluation criteria and methods based on teachers' subject areas and roles. Personalized evaluation outcomes can help teachers identify areas for improvement and encourage them to take initiative in their professional development and career planning. Evaluation standards for vocational education teachers should comprehensively address all aspects of their responsibilities, not only focusing on teaching and research outcomes but also considering the entire teaching process. This will facilitate a more

holistic and systematic evaluation, creating greater opportunities for vocational education teachers to enhance both their teaching abilities and scientific research levels. Reforming the evaluation system will strengthen teachers' perceptions of fairness in salary distribution, further motivating them to improve their work performance. Additionally, government incentive policies for vocational colleges and teachers play a crucial role. As vocational education serves as a training ground for high-tech and skilled talent, it imposes higher demands on teachers' professional skills. Government policies can effectively attract professionals with technical expertise from industry to engage in teaching and training students. This will, in turn, help optimize the structure of the teaching workforce, creating a group of vocational educators with complementary knowledge and skills. By promoting deeper integration between industry and education and fostering closer school-enterprise collaboration, the synergistic effect of these partnerships can be maximized.

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Author contributions

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Conflict of interest

The authors have no conflicts of interest to declare.

Data availability statement

No additional data.

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