

# Enhancing the Quality and Adaptability of Vocational Education to Promote High-Quality Development: Taking Hainan Vocational University of Science and Technology as an Example

Linyin Yan<sup>1\*</sup>, Yu Zhang<sup>1</sup>, Rongping Yuan<sup>2\*</sup>, Xuan Zong<sup>3</sup>

<sup>1</sup>Hainan Vocational University of Science and Technology, Haikou 571126, Hainan Province, China

<sup>2</sup>Beijing University of Chemical Technology, Beijing 100029, China

<sup>3</sup>Management & Science University (MSU), Shah Alam 40100, Selangor, Malaysia

\*Corresponding authors: Linyin Yan, [yanlinyinyin@iccas.ac.cn](mailto:yanlinyinyin@iccas.ac.cn); Rongping Yuan, [249536728@qq.com](mailto:249536728@qq.com)

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**Abstract:** This paper aims to explore effective strategies for overcoming the five core challenges currently faced by vocational education: challenges in defining the educational type, variations in the quality of incoming students and their learning abilities, the need to improve teaching quality and effectiveness, urgent requirements for optimizing the quality of teaching staff, and insufficient depth in the integration of industry and education. By analyzing the root causes of these challenges, this paper proposes a series of targeted strategies and measures. Taking the School of Chemistry and Materials Engineering at Hainan Vocational University of Science and Technology as an example, the paper elaborates on how the school has significantly enhanced the adaptability and teaching quality of vocational education through precise positioning of vocational education types, strengthening the construction of teaching staff, optimizing teaching methods and content, and deepening the integration of industry and education. The research results indicate that these initiatives not only effectively address key issues in vocational education but also promote comprehensive improvements in students' overall qualities and employment competitiveness, providing valuable insights and practical references for advancing the high-quality development of vocational education. Furthermore, by introducing the practice of the School of Chemistry and Materials Engineering at Hainan Vocational University of Science and Technology in tailoring vocational education development to local conditions, this paper validates the reliability and feasibility of the proposed solutions.

**Keywords:** Vocational education; Adaptability; Positioning; Industry-education integration; "Dual-qualified" teachers; "Dual-system" vocational education standards

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## 1. Introduction

In the current era, vocational education, as a crucial component of the national education system and human resource development, is becoming increasingly significant <sup>[1]</sup>. Although distinct from general education in type, vocational education holds an equally important position and role in driving social progress, economic development, and individual career growth <sup>[2-5]</sup>. In April 2021, President Jinping Xi issued important instructions on vocational education, explicitly stating that “vocational education has a promising future and great potential in the new journey of fully building a socialist modern country.” This directive has charted the course for the future development of vocational education and injected new impetus into it <sup>[6,7]</sup>.

To better adapt to the talent demands of industrial restructuring, China officially implemented the newly revised Vocational Education Law on May 1, 2022 <sup>[8-10]</sup>. This legal revision not only reflects the state’s high regard for vocational education but also marks the entry of vocational education into a new phase of development. However, adaptability is both a typical characteristic and a long-standing pain point in the development process of vocational education. On one hand, adaptability manifests in vocational education’s ability to swiftly adjust its curriculum and training content in response to market demands and industry changes, thereby meeting the employment needs of enterprises and society. This typical characteristic ensures that vocational education remains closely aligned with economic and social development. On the other hand, adaptability has also been a persistent pain point for vocational education, as the complex and challenging tasks of accurately predicting future industry trends, promptly adjusting teaching resources, and ensuring education quality require joint efforts and continuous investment from educational institutions, the government, and all sectors of society. Enhancing the adaptability of vocational education to better serve economic and social development has become an urgent issue to be addressed <sup>[11-13]</sup>.

Enhancing adaptability is the primary direction for promoting the high-quality development of vocational education, as well as the key to improving its value and attractiveness <sup>[14,15]</sup>. Currently, the scale of vocational education in China ranks at the forefront globally, but in the process of rapid development, it also faces numerous difficulties and challenges <sup>[16-21]</sup>. Specifically, vocational education encounters five major issues: difficulty in type positioning, poor quality of student intake, low teaching quality, insufficient teaching staff, and shallow integration of industry and education. These issues severely constrain the further development of vocational education and impact its ability to serve economic and social development <sup>[22-25]</sup>.

Therefore, to continuously enhance the adaptability of vocational education and promote its high-quality development, this paper proposes specific suggestions from the aspects of precise positioning, strengthening characteristic development, focusing on quality, enhancing the essence of education, achieving synchronous resonance, deepening the integration of industry and education, and fostering multi-party collaboration to mitigate educational excessive competition. It is hoped that the implementation of these measures will provide beneficial references and insights for the future development of vocational education in China.

## 2. Five major difficulties and challenges in the development of vocational education

### 2.1. Difficulty in type positioning

Vocational education, as a distinct type of education, is rooted in the classification of job positions, which fundamentally differs from general education, which is based on the classification of academic disciplines. Vocational education exhibits unique attributes in its training objectives, curriculum system, and educational methods, aiming to cultivate high-quality technical talents with professional skills and practical skills to meet the diversified needs of economic and social development <sup>[26-28]</sup>.

However, for a long time, the development of vocational education in China has faced the dilemma of inaccurate type positioning. This dilemma stems from traditional prejudices and misunderstandings towards vocational education in society, specifically manifested as a widespread mindset of “valuing general education over vocational education,” “emphasizing academic talents over technical talents,” and “prioritizing knowledge imparting over practical training.” These prejudices not only affect the social recognition of vocational education but also restrict the investment and optimization of vocational education resources, further exacerbating the imbalanced development between vocational and general education <sup>[29-31]</sup>.

Within vocational education institutions, the issue of unclear type positioning is equally prominent. According to relevant survey data, some vocational undergraduate colleges have obvious defects in the design of their talent training programs, specifically manifested as unclear positioning and lack of distinctive features. Some schools simply imitate the training models of applied universities or follow the traditional programs of higher vocational education at the diploma level, failing to conduct in-depth research and formulation based on the growth patterns of undergraduate-level talents. This approach not only fails to effectively reflect the connotation and characteristics of vocational education but also makes it difficult to cultivate high-quality technical and skilled talents that meet market demands, thereby restricting the overall development quality and competitiveness of vocational education <sup>[2,32-34]</sup>.

## **2.2. Poor quality of student intake**

In the context of an aging society, vocational education is facing a severe challenge of poor student quality. This may be attributed to the gradual decrease in the population of school-age individuals and the continuous diversion of traditional student sources by regular universities and overseas institutions. These two trends make the difficulty of enrollment in higher vocational education a long-term issue in the future. This dilemma not only affects the scale of vocational education’s development but also poses a severe test to its education quality and talent cultivation <sup>[35-37]</sup>.

The unqualified basic education level of incoming students is a major problem faced by vocational education. Many secondary and higher vocational schools have to lower their admission scores to maintain their enrollment size, resulting in a large number of students with weak academic foundations entering vocational schools. Especially at the secondary vocational level, students’ cultural literacy and learning abilities are generally low, which undoubtedly increases the difficulty and complexity of teaching organization <sup>[36-40]</sup>. Taking the 2021 National College Entrance Examination as an example, the minimum admission score for higher vocational education (diploma level) in various provinces ranged from 200 to 400 points. This score level makes the “easy to enter, hard to exit” educational model face enormous challenges in practice <sup>[41-44]</sup>.

Furthermore, the influx of diversified student sources has also brought new challenges to the admission and examination system of vocational education <sup>[41-44]</sup>. The unified national college entrance examination adopts the same standards for both higher vocational colleges and regular universities. This “one-size-fits-all” examination method fails to distinguish between the characteristics and needs of different types of education and cannot reflect the distinctive feature of vocational education that emphasizes skills. In recent years, the sources of vocational education students have also broken through the limitations of traditional sources, encompassing diverse sources of over ten types, including ex-servicemen, laid-off workers, migrant workers, and more <sup>[45-48]</sup>. These students have different identities and learning needs, and there is a clear mismatch between their varied qualities and the traditional classroom teaching system and teaching management.

The talent selection criteria that emphasize cultural knowledge over skills are also one of the important

reasons for the poor quality of vocational education student sources <sup>[40,49,50]</sup>. According to the independent admission examination schemes of higher vocational colleges in various provinces since 2014, more than half of the provinces have not specified the proportion of skill test scores, and only about a quarter of the provinces have explicitly stipulated that skill test scores should not be lower than cultural quality scores. Although all provinces require the organization of vocational skill examinations, there are no clear arrangements for “what to test” and “how to test,” leaving the decision-making power to each admitting school. This lack of unified standards and norms not only hinders higher vocational education from recruiting suitable students but also affects the quality of talent cultivation in vocational education and social recognition <sup>[45-48]</sup>.

### **2.3. Lack of reasonable standards for teaching quality**

Teaching quality is the lifeblood of vocational education. It directly relates to the improvement of students' skill levels and the enhancement of their employment competitiveness. However, current vocational education faces numerous challenges in terms of teaching quality. Among them, the unreasonable layout of professional structures, inadequate practical conditions, and limited funding are the three major issues commonly encountered in improving the teaching quality of vocational education <sup>[51-53]</sup>.

Firstly, the unreasonable layout of professional structures is a key factor restricting the improvement of vocational education's teaching quality <sup>[54-56]</sup>. Currently, the professional settings of vocational education often fail to align well with the needs of regional industrial development, leading to a disconnect between talent cultivation and market demand. The phenomenon of duplicated and low-level professional construction remains serious, which not only wastes educational resources but also reduces the overall teaching quality of vocational education. Meanwhile, vocational education lacks notable brands and distinctive specialties with industry influence and competitiveness, making it difficult to attract high-quality student sources and enterprise cooperation. Taking Shaanxi Province as an example, some enterprises have reflected that few vocational colleges are willing to jointly cultivate technical and skilled talents in urgently needed fields such as non-ferrous metallurgy and modern agriculture. This reflects the lag and inadequacy of vocational education in professional settings.

Secondly, inadequate practical conditions are another important factor restricting the improvement of vocational education's teaching quality <sup>[57,58]</sup>. Vocational education emphasizes practical teaching and skill cultivation. However, many vocational colleges currently face the issue of inadequate practical conditions, mainly manifested in limited practice spaces and outdated or lacking equipment, which cannot meet the needs of students' skill training. The inadequacy of practical conditions not only affects the improvement of students' skill levels but also limits the in-depth development of vocational education in areas such as industry-education integration and school-enterprise cooperation.

Lastly, limited funding is a bottleneck issue restricting the improvement of vocational education's teaching quality <sup>[59-62]</sup>. According to statistics from UNESCO, the operating costs of vocational education are about three times that of general education, mainly due to the substantial investment and continuous updating and maintenance required for the venues and equipment needed for vocational education practices. However, currently, the number of higher vocational education students accounts for over 55% of the entire higher education population, while the direct financial investment received by higher vocational education only accounts for about 20% of the entire higher education budget. This mismatch between investment and demand results in shortages in teaching resources and faculty construction for vocational education, severely constraining the improvement of teaching quality.

## 2.4. Significant shortage of high-quality teachers

Vocational education, as a crucial field for teachers to impart professional skills and knowledge, directly impacts teaching quality and student cultivation outcomes through the quality of its teachers. However, the current state of vocational education faces significant challenges in terms of teacher quality, particularly with numerous issues surrounding the development of the “dual-qualified” teaching faculty, which has become one of the bottlenecks restricting the high-quality development of vocational education<sup>[63-65]</sup>.

“Dual-qualified” teachers, who possess both professional theoretical knowledge and practical skills, are key to the robust support of vocational education. Nevertheless, the current “dual-qualified” teaching faculty generally exhibits strong professional theory but relatively weak practical and teaching abilities. This unbalanced capability structure directly affects the teaching quality of vocational education and the cultivation of students’ practical skills<sup>[66,67]</sup>. Taking Jiangsu University of Technology<sup>[66,67]</sup> as an example, a specialized survey found multiple issues in the training and development of vocational education teachers, such as a lack of theoretical guidance for professional development, insufficient planned guidance for in-service training, a lack of concurrent evaluation and guidance for teaching practice, and inadequate mentorship and guidance in team building. These issues not only constrain the individual professional development of teachers but also impact the overall teaching quality of vocational education.

Furthermore, at the national level, there is no unified national certification standard for “dual-qualified” teachers, resulting in uneven standards set by local authorities. Although these standards have, to some extent, promoted an increase in the proportion of “dual-qualified” teachers, they fail to effectively guarantee the dual qualifications of the teaching faculty. When promoting the development of “dual-qualified” teachers, governments at all levels tend to focus more on the proportion of teachers rather than their quality<sup>[65,68-70]</sup>. This emphasis on quantity over quality further exacerbates the issue of suboptimal teacher quality.

On the other hand, enterprises, as important partners in vocational education, exhibit low enthusiasm for participating in the cultivation of “dual-qualified” teachers. This is primarily due to the lack of motivation and mechanisms for enterprises to engage in vocational education, as well as insufficient policy support from the government in guiding enterprise participation<sup>[71,72]</sup>. The low participation of enterprises not only limits the enhancement of teachers’ practical skills but also affects the close integration of vocational education with industrial development.

## 2.5. Limited depth in industry-education integration

Industry-education integration and school-enterprise cooperation, as the core characteristics of vocational education, are key pathways to promoting high-quality vocational education development and achieving effective connections between the education chain and the industry chain<sup>[73,74]</sup>. However, in practice, industry-education integration often faces the awkward situation of “enthusiastic schools but uninterested enterprises,” with low enterprise participation and insufficient depth of cooperation, posing another significant challenge to the development of vocational education<sup>[29,75,76]</sup>.

Currently, the primary motivation for most enterprises to participate in industry-education integration is to acquire skilled talents to meet their own development needs. Nevertheless, with the increasing proportion of secondary vocational education students pursuing further studies and the diversification of employment choices for higher vocational students, enterprises face the risk of “drawing water with a bamboo basket.” Secondary vocational education has shifted from a pure “employment-oriented” approach to one that emphasizes “both further studies and employment,” a transformation that has significantly increased students’ willingness to

pursue further education <sup>[77-79]</sup>. According to a survey by Peking University involving nearly 17,000 samples, the employment rate of secondary vocational graduates nationwide was only 35% in 2020, while the rate of pursuing further studies reached about 65%. Similarly, the desire for further studies among college graduates is also strong, with about one-third of college students choosing to pursue a bachelor's degree each year, and some colleges even reporting a "junior college to university" transition rate of up to 80%. This trend makes it difficult for enterprises to obtain a stable source of skilled talents through industry-education integration, especially for those participating in "dual-system" programs, as students still belong to the school, leaving enterprises with few effective means to retain them when they choose to pursue further studies <sup>[80-83]</sup>.

On the other hand, the limited short-term benefits and long-term expectations that enterprises obtain from industry-education integration and school-enterprise cooperation are also important factors affecting their participation enthusiasm <sup>[84,85]</sup>. Although industry-education integration theoretically enables enterprises to cultivate skilled talents and innovate technologically, in practice, due to issues such as inadequate cooperation mechanisms, insufficient policy support, and unclear benefit distribution, enterprises often struggle to reap substantial benefits <sup>[75,76,86,87]</sup>. This makes enterprises cautious when facing industry-education integration, lacking sufficient motivation and enthusiasm to engage deeply.

### **3. Suggestions for promoting high-quality development of vocational education**

#### **3.1. Precise positioning and strengthening characteristic development**

As a unique type within the education system, vocational education bears the important mission of cultivating high-quality skilled talents and serving economic and social development, possessing irreplaceable value. To promote the high-quality development of vocational education, it is imperative to first clarify its precise positioning and strengthen characteristic development.

The implementation of the newly revised Vocational Education Law provides a strong legal guarantee for the precise positioning of vocational education. We should seize this opportunity to fully leverage the fundamental, long-term, and strategic functions of the Vocational Education Law as a higher-level law, further reinforcing the social consensus that vocational education holds an equally important status as general education. This not only helps to elevate the social status and recognition of vocational education but also creates a more relaxed and favorable environment for its development <sup>[88-90]</sup>.

Based on a clear positioning of vocational education, it is particularly important to accelerate the introduction of supporting legal systems. This includes revising relevant existing laws to ensure their effective integration with the Vocational Education Law; formulating implementation details, judicial interpretations, administrative regulations, etc., to refine the relevant provisions of the Vocational Education Law and enhance its operability and enforceability. Through these measures, we can continuously improve and perfect the legal system of vocational education, providing a solid institutional guarantee for the legalization process of vocational education <sup>[91-93]</sup>.

Furthermore, optimizing the internal and external environments for the development of vocational education is also key to promoting its high-quality development. This requires us to give more attention and preference to vocational education in terms of policy formulation, funding investment, and social support, while strengthening communication and collaboration between vocational education, general education, and the industry to form favorable collaborative development. Only in this way can we fully leverage the distinctive advantages of vocational education, cultivate more high-quality skilled talents that meet market demand, and

provide strong talent support for economic and social development <sup>[94-96]</sup>.

### **3.2. Classified selection to attract suitable students**

The high-quality development of vocational education cannot be achieved without the support of high-quality students. As an important pathway for selecting students, the higher vocational college entrance examination system must follow the principle of classified selection to attract and select students suitable for vocational education in a more scientific and reasonable manner. The examination should emphasize students' practical and hands-on abilities, which is both an essential requirement of vocational education and an inevitable choice for cultivating high-quality technical and skilled talents. Therefore, we must accelerate the improvement of the "vocational education college entrance examination" system and promote it as the main channel for the admission of higher vocational colleges and vocational undergraduate programs <sup>[97-99]</sup>. In this process, it is crucial to fully tap into the high-quality student sources among secondary vocational school graduates. These students, who have already acquired certain professional knowledge and skills during their secondary vocational education, form an important foundation for vocational education.

In the system design of the "vocational education college entrance examination," the examination subjects, content, and methods should all reflect a practice-oriented approach, emphasizing the assessment of problem-solving skills. This not only highlights the type characteristics of vocational education but also effectively avoids the sole reliance on scores in the exam, preventing examination results, especially written exam scores, from becoming the single or main criterion for evaluation. We should avoid the practice of "one test for all" and instead design differentiated examinations based on the diversity and complexity of the student sources <sup>[100-103]</sup>. Specifically, for secondary vocational students, who have already mastered more professional knowledge, we can appropriately increase the proportion of skill tests in the examination; for laid-off workers, who have acquired certain vocational skills, we can also increase the proportion of skill tests; and for high school students, who have a good foundation in cultural knowledge, we can increase the proportion of cultural quality tests in the examination, with a focus on recruiting students for majors that require a higher level of cultural knowledge, such as human resources and business administration.

In addition, to ensure the fairness, impartiality, and transparency of the higher vocational college entrance examination, we must strengthen supervision and management. It is necessary to strengthen the supervision of various stages of the classified examination for higher vocational colleges, including promotion, registration, examination, and admission, and severely crack down on illegal and irregular behaviors such as false promotion and entrusting intermediary agencies with recruitment <sup>[97,104,105]</sup>. Only in this way can we ensure the selection of students who are truly suitable for vocational education and provide a strong guarantee of student sources for the high-quality development of vocational education.

### **3.3. Reform and innovation to improve educational quality**

Educational quality is the lifeline of vocational education and a core element in promoting its high-quality development. To improve the educational quality of vocational education, we must carry out reforms and innovations, starting from aspects such as specialty settings and investment mechanisms, to comprehensively enhance the adaptability and competitiveness of vocational education.

Reasonable specialty settings are key to improving the quality of vocational education <sup>[106-108]</sup>. Vocational colleges should actively align with the needs of regional economic construction and social well-being, focusing on urgent and scarce areas, and setting specialties reasonably. This includes guiding vocational colleges to

set majors related to advanced manufacturing, modern service industries, preschool education, elderly care, housekeeping, and other fields to meet society's demand for high-quality technical and skilled talents. At the same time, strict control should be exercised over the setting of specialties corresponding to restricted and eliminated industries to ensure the effective allocation and utilization of vocational education resources. By setting specialties reasonably, vocational colleges can strengthen their characteristics and enhance their ability to serve the industry.

A sound investment mechanism is an important support for ensuring the quality of vocational education [59,61,62]. Given the relatively limited total amount of financial education funding, we must optimize the expenditure structure to ensure that vocational education receives sufficient financial support. This includes incorporating the allocation of new education funding toward vocational education into the scope of supervision and evaluation, and strengthening the responsibility of governments at all levels for investing in vocational education. At the same time, we should also introduce incentive policies to guide industries and enterprises to establish or participate in vocational education, support social forces to participate in the establishment of mixed-ownership, joint-stock, and other vocational colleges with capital, technology, and other elements, and enjoy corresponding rights. By attracting social participation, we can broaden the funding sources for vocational education and provide a strong financial guarantee for improving educational quality.

In the process of reform and innovation, we should also pay attention to enhancing the governance capacity and management level of vocational colleges [109-111]. This includes strengthening the internal management of vocational colleges, improving the governance structure, enhancing management efficiency; strengthening the construction of the teaching staff, improving teachers' professional qualities and teaching abilities; strengthening school-enterprise cooperation, promoting the integration of education and industry, and enhancing the practicality and applicability of vocational education.

### **3.4. Focusing on quality and enhancing the competence of “dual-qualified” teachers**

In the vocational education system, “dual-qualified” teachers serve as a bridge between theory and practice, as well as between education and industry. They play an irreplaceable role in improving teaching quality and enhancing students' practical skills. Therefore, focusing on quality and enhancing the competence of “dual-qualified” teachers is a crucial aspect of promoting high-quality vocational education [9,112,113].

Firstly, establishing and improving the national standards for the recognition and admission of “dual-qualified” teachers in vocational education is fundamental [114-116]. This not only ensures the quality of “dual-qualified” teachers but also facilitates the mutual recognition and mobility of such teachers across regions, thereby optimizing the allocation of teacher resources and enhancing the overall teaching level. At the same time, it is vital to strengthen policy implementation supervision and improve the accountability mechanisms and evaluation standards for government policies related to “dual-qualified” teachers at all levels. This requires attention to both the quantity and proportion of teachers, as well as their proficiency and teaching effectiveness, ensuring that the construction of the “dual-qualified” teacher workforce is both substantial in size and high in quality.

Secondly, improving the supporting implementation rules and fully absorbing the experience of local reforms and explorations in “dual-qualified” teachers is an effective way to enhance their competence [117-119]. For operational content that aligns with local realities, innovative exploration should be encouraged, while ensuring consistency with the value orientation of central policies. For example, incentive policies such as benefit compensation and tax exemptions can be introduced for local enterprises participating in the



construction of “dual-qualified” teachers, thereby stimulating their enthusiasm for participation.

Furthermore, implementing a personnel mechanism that combines “fixed positions” with “flexible positions” in vocational colleges is an important measure to enhance the flexibility and practicality of the “dual-qualified” teacher workforce <sup>[63,120,121]</sup>. By introducing enterprise technical and skilled talents as part-time teachers through flexible means, the principle of “not seeking ownership but seeking utilization” can be achieved, effectively supplementing the practical teaching force of vocational colleges.

Lastly, vocational education institutions should strengthen proactive communication with government departments, industries, and enterprises to enhance their ability to serve local economic and enterprise development <sup>[85]</sup>. By attracting more enterprises to participate in the construction of the “dual-qualified” teacher workforce and achieving collaborative win-win results in resource and equipment sharing, as well as bidirectional personnel flow, the deep integration of vocational education and industrial development can be further promoted, providing strong talent and intellectual support for the high-quality development of vocational education.

### **3.5. Deepening industry-education integration**

On the journey towards high-quality development of vocational education, deepening industry-education integration and achieving symbiotic and win-win development through school-enterprise cooperation are key paths to enhancing the adaptability of vocational education and promoting close alignment between education and industry <sup>[122,123]</sup>. Industry-education integration not only requires vocational education to resonate with industry demands but also necessitates the construction of a school-enterprise community of shared interests. Through a dual-subject education model, the effective connection of the education chain, talent chain, industry chain, and innovation chain can be promoted.

Firstly, constructing a school-enterprise community of shared interests is the core of deepening industry-education integration <sup>[124-127]</sup>. This means that vocational colleges and enterprises should become equal partners, jointly formulating talent training programs to ensure a high degree of alignment between educational content and enterprise demands. Both parties should collaborate on developing curriculum materials, incorporating the latest industry knowledge, technical standards, and enterprise culture into teaching, so that students can apply what they learn, thereby shortening the distance between theory and practice.

Secondly, implementing a dual-subject school-enterprise education model requires that professional settings closely match industry demands <sup>[128,129]</sup>. Vocational colleges should actively align with regional economic development strategies and emerging industry trends, flexibly adjusting professional settings to ensure effective alignment between educational supply and market demand. At the same time, by moving classrooms to production lines and aligning teaching with production processes, “immersive” teaching targeted at actual enterprise production can be conducted, allowing students to learn and grow in real work environments and enhancing their ability to solve practical problems.

Furthermore, providing sufficient practical teaching and experimental training projects is an important guarantee for improving the quality of vocational education <sup>[125,130]</sup>. Vocational colleges should ensure that students have enough time for on-the-job internships and avoid mismatches between students’ majors and internship units. Through school-enterprise cooperation, stable training bases can be established to provide students with abundant practical opportunities. This not only enhances students’ professional skills but also helps them better adapt to future workplace demands.

Lastly, facilitating a cooperative mechanism for bidirectional flow and interaction between school and

enterprise personnel is key to promoting vocational education's proactive adaptation to industrial restructuring and technological changes<sup>[124-127]</sup>. By establishing mechanisms such as mutual personnel exchanges and shared resource libraries, the exchange and sharing of knowledge, skills, and experience can be promoted, driving the deep integration of vocational education and industrial development. This interaction not only helps improve teachers' practical teaching abilities but also brings new ideas and solutions to enterprises, achieving a win-win situation for both education and industry.

#### **4. Practice of promoting vocational education development by the School of Chemistry and Materials Engineering at Hainan Vocational University of Science and Technology**

Since its establishment in 2008, the School of Chemistry and Materials Engineering at Hainan Vocational University of Science and Technology has closely aligned itself with key industries in Hainan, such as oil and gas, petrochemical new materials, biomedicine, and high-end food processing. It has established undergraduate and vocational specialties in Applied Chemical Technology, Pharmaceutical Engineering Technology, and others, constructing a comprehensive education and teaching system aimed at cultivating high-quality skilled talents<sup>[131-134]</sup>. Facing the five major challenges of vocational education, the school leverages Hainan's geographical advantages, strives for policy support, and closely follows national development strategies, exploring a path for vocational education development that integrates both regional and contemporary characteristics.

In the field of vocational education research, the school focuses on 15 key areas including moral education, the positioning of vocational education, and industry-education integration. Addressing issues of scattered, weak, and superficial research, the school has identified four key research foci: demand-oriented forward-looking research; strengthened teamwork for collaborative problem-solving; systematic and in-depth genuine research; and practical results-oriented research that proposes effective countermeasures and suggestions. Guided by these principles, the school contributes wisdom and strength to the sustained and healthy development of vocational education.

##### **4.1. Precise positioning of education type and deep alignment with industry demands**

In response to the widespread challenge of defining the type of vocational education, the School of Chemistry and Materials Engineering at Hainan Vocational University of Science and Technology has taken proactive and effective measures<sup>[131,135]</sup>. The school has carefully designed five specialties with prominent vocational attributes and close industry connections, including Applied Chemical Technology and Pharmaceutical Engineering Technology, centering around the development needs of Hainan's oil and gas industry, pharmaceutical industry, and low-carbon manufacturing. The educational content of these specialties closely aligns with the actual needs of industry development. Graduates are highly sought after by large and medium-sized petrochemical and pharmaceutical enterprises, which annually hold talent recruitment presentations at the school to compete for outstanding talents.

To achieve this goal, the school actively collaborates with renowned enterprises such as Hainan Jinhai Pulp and Paper Co., Ltd. and Hainan Handi Sunshine Petrochemical Co., Ltd. By continuously adjusting the curriculum and introducing the latest industry technologies, the school ensures that students acquire practical knowledge and skills, achieving the teaching objective of applying what they learn<sup>[136]</sup>.

Currently, graduates from the school have successfully secured employment in well-known enterprises

such as Sinopec Hainan Refining and Chemical Co., Ltd., its Maoming, Zhenhai, and Jinling branches, Zhejiang Hengyi Petrochemical Research Institute Co., Ltd., Zhuhai Wanhua Chemical Co., Ltd., and Hainan Huasheng New Material Technology Co., Ltd., primarily engaging in roles related to chemical enterprise management, petroleum refining, oil and gas processing and production operations, chemical product analysis, pharmaceutical production, drug analysis, food inspection, food quality and safety management and supervision, and food research and development. Some alumni have played significant roles in key leadership and technical positions within these companies, contributing to the development of enterprises in Hainan and surrounding areas and establishing a good reputation in the industry.

#### **4.2. Strengthening faculty development and hardware facilities to comprehensively improve teaching quality**

In response to the dual challenges of student quality and teaching quality, the School of Chemistry and Materials Engineering at Hainan Vocational University of Science and Technology has taken robust measures. In terms of faculty development, the school has continuously strengthened its forces through a combination of precise recruitment and targeted training, significantly expanding its senior faculty with professor and associate professor titles. The school is honored to have academician Handong Sun as a visiting professor, providing strong intellectual support for its teaching efforts. This initiative has notably enhanced the school's teaching level and academic influence. In addition to strengthening faculty development, the school actively involves enterprise experts in teaching through school-enterprise cooperation. By implementing a "dual-teacher system" teaching mode, where teachers from both the school and enterprises jointly teach, the school effectively enhances the practicality and relevance of teaching, enabling students to better apply their knowledge in practical work. Through conducting research projects on this platform, the school not only advances its research efforts but also feeds research findings back into teaching, significantly improving teaching quality and students' practical skills.

These measures have yielded remarkable results. In the past three years, students from the school have won numerous awards, including over 20 provincial-level or higher honors, and several have received national scholarships. Additionally, students have excelled in various large-scale competitions such as the National College Students' Mathematical Modeling Contest, the Guangdong-Hong Kong-Macao Greater Bay Area Financial Mathematical Modeling Contest, the Provincial Round of the National College Students' Mathematics Competition, the National Academic English Vocabulary Contest, and the Hainan Provincial College Students' Chemical and Chemical Engineering Skills Competition. In the past two years, the proportion of undergraduate graduates from the school pursuing graduate studies has exceeded 3%, with over half being admitted to "211" universities such as Hainan University, Yunnan University, and Yanbian University, further demonstrating the school's teaching quality and students' comprehensive qualities.

#### **4.3. Optimizing faculty structure and comprehensively improving teacher quality**

Addressing the crucial issue of suboptimal teacher quality, the School of Chemistry and Materials Engineering at Hainan Vocational University of Science and Technology has adopted a dual-drive strategy of "recruitment + training" to comprehensively enhance the overall quality of its teaching faculty<sup>[131]</sup>. In terms of recruitment, the school actively seeks teachers with rich industry experience and senior titles, injecting new vitality and professional strength into the school. The addition of these teachers not only brings advanced teaching concepts and methods to the school but also provides students with more practical experience and industry insights. In

terms of training, the school focuses on improving the professional competence and teaching abilities of existing teachers. By organizing domestic and international training, academic exchanges, and enterprise practice activities, the school provides teachers with a broad platform for learning and development. These activities not only broaden teachers' horizons but also enhance their teaching and research capabilities. Simultaneously, the school encourages teachers to actively participate in enterprise projects, promoting the deep integration of theory and practice. This cooperation mode not only helps teachers better understand industry needs and the latest trends but also integrates practical work experience into teaching, thereby enhancing students' practical skills and employment competitiveness.

Through the implementation of this dual-drive strategy, the School of Chemistry and Materials Engineering at Hainan Vocational University of Science and Technology has successfully optimized its faculty structure and comprehensively improved teacher quality, providing a strong talent guarantee for the school's research on vocational education adaptability.

#### **4.4. Deepening the industry-education integration mechanism to promote collaborative innovation and development**

In response to the issue of insufficient depth in industry-education integration within vocational education, the School of Chemistry and Materials Engineering at Hainan Vocational University of Science and Technology actively seeks deep cooperation with industries. It has established close partnerships with over 20 enterprises across various sectors, including oil and gas, pharmaceuticals, and food, achieving an organic integration and connection between the education chain, talent chain, industry chain, and innovation chain.

Through various means such as jointly establishing training bases with enterprises, conducting collaborative research projects, and mutually hiring faculty, the school not only provides students with abundant internship and training opportunities, enabling them to hone their skills in real-world work environments, but also facilitates the rapid conversion of research findings, achieving a win-win situation for both academic research and industrial application<sup>[137]</sup>. For instance, the cooperation with Hainan Sinopec Marketing Co., Ltd. has not only enhanced students' professional skills in production safety management but also provided strong talent support for the enterprise, thereby bolstering its competitiveness<sup>[131]</sup>.

Furthermore, the school actively engages in social services, strengthens internal development, and highlights its unique educational features. In recent years, it has signed in-depth school-enterprise cooperation agreements and industry-education integration framework agreements with enterprises across multiple sectors, achieving deep integration and collaborative development in areas such as social services, student internships and training, mutual faculty hiring, educational reform, and research project cooperation. The faculty team of the school has provided skill training and assessment services for numerous enterprises, technical consultations for government agencies, and professional technical services such as production safety accident investigations, production safety hazard identifications, and production safety management training for various institutions, making positive contributions to local economic and social development.

By deepening the industry-education integration mechanism, the School of Chemistry and Materials Engineering at Hainan Vocational University of Science and Technology has successfully promoted collaborative innovation and development, enhancing the adaptability and competitiveness of vocational education.

#### **4.5. Highlighting educational features and strengthening competitiveness in research and social services**

The five majors established by the School of Chemistry and Materials Engineering at Hainan Vocational University of Science and Technology not only have distinct vocational attributes but also offer wide employment prospects, with graduates highly sought after by major enterprises. The school has always placed great emphasis on practical teaching, striving to provide students with the best learning and practical environments. To meet the needs of industry development, the school continuously constructs and upgrades experimental and training laboratories, and actively procures advanced equipment, providing strong support for students' practical learning.

Moreover, the school has established a petrochemical technology professional vocational education training base supported by the central government's finances and a distinctive training and teaching demonstration center among universities in Hainan Province. The construction of these bases and centers has further enhanced the school's practical teaching level. In 2011, the school established a vocational skill level evaluation site for the chemical industry, gaining assessment qualifications for various job categories such as chemical process controllers, inorganic chemical reaction production workers, organic synthesizers, chemical inspectors, chemical synthetic pharmacists, and biochemical pharmaceutical manufacturers, thus providing a solid guarantee for students' vocational skill improvement.

In January 2016, the establishment of the Hainan Haike Petrochemical Products Testing Center marked a new milestone for the school in research and social services. This center not only conducts analysis and testing of petroleum products for society but also serves students' on-campus training, providing strong support for their practical learning and the school's research activities.

In recent years, graduates from the school have played significant roles in large and medium-sized petrochemical and pharmaceutical enterprises, engaging in various positions such as chemical enterprise management, petroleum refining, and pharmaceutical production. Some outstanding graduates have grown into company leaders and technical backbones, earning the school a good reputation. Meanwhile, the faculty team of the school actively provides skill training and assessment services for enterprises, such as chemical inspectors and chemical process controllers, as well as professional technical services like production safety accident investigations and production safety hazard identifications, winning widespread praise and recognition from society. These achievements fully demonstrate the school's educational features and competitiveness in research and social services.

### **5. Conclusion**

This paper delved into the core strategies for effectively addressing the five major challenges faced by vocational education: the vague definition of education types, a weak student base, uneven teaching quality, the need for teacher quality improvement, and the insufficient integration of industry and education. These strategies include precisely positioning vocational education types, enhancing teaching staff and improving teaching quality, optimizing the quality of the teaching faculty, and deepening the integration of industry and education. Taking the College of Chemistry and Materials Engineering at Hainan Vocational University of Science and Technology as a case study, this paper meticulously analyzed how the college, leveraging Hainan Province's unique geographical location and resource advantages, closely aligns with regional industrial development needs. This alignment has not only significantly bolstered the college's educational and research

capabilities but also substantially enhanced graduates' employability and adaptability to society.

The practical exploration undertaken by the College of Chemistry and Materials Engineering at Hainan Vocational University of Science and Technology provides invaluable experience and a successful model for enhancing the adaptability of vocational education and promoting its high-quality development. In the future, it is imperative to continuously deepen reforms in the field of education and teaching, further strengthen the integration of industry and education, and consistently elevate the overall quality of the teaching faculty and teaching quality. By more precisely matching the needs of industrial development, we can cultivate a greater number of high-quality technical and skilled talents who possess both the spirit of craftsmanship and innovative abilities, thereby injecting stronger impetus into the sustained development of the economy and society.

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