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Practical exploration on empowering collaborative education in the second classroom of vocational undergraduate education with industrial resources in the Greater Bay Area

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Abstract: Vocational undergraduate education plays a crucial role in fostering high-level technical and skilled talents and supporting regional industrial upgrading. Collaborative education, particularly the integration of second classrooms with professional education, is a key factor in enhancing practical teaching quality. Shenzhen Polytechnic University leverages the abundant industrial resources of the Greater Bay Area through a series of "Youth University Innovation and Research in the Greater Bay Area" practical teaching activities. This has led to the development of a comprehensive, four-part collaborative education system: "teaching objectives – content design – implementation path – evaluation and feedback." This system establishes a pattern of "first classroom – foundation, second classroom – application, and industrial resources – support". Practical experience demonstrates that this system effectively addresses the challenges of "second classrooms being detached from professional fields, lacking practical application, and disconnected from industry". It significantly improves students' professional practical skills, innovation capabilities, and industry awareness, providing a replicable and adaptable model for similar vocational schools.

Keywords: vocational undergraduate; industry-academia integration; second classroom; practical teaching

1 Problem statement

Vocational undergraduate education is a vital component of higher education, tasked with cultivating high-level technical and skilled personnel to support regional industrial upgrading. Unlike traditional undergraduate programs, vocational programs place a strong emphasis on the development of "technical application + innovation capabilities", requiring students to possess practical skills for applying professional knowledge to solve real-world industry problems. *The Catalogue of Vocational Education Specialties (2021)* and its 2024 supplementary addition explicitly emphasize the importance of practical teaching, advocating for its prominent role. The "Second Classroom" serves as a crucial supplementary learning platform alongside the traditional classroom. However, many vocational schools' second classrooms have historically exhibited a tendency towards "superficial activity and marginalization", leading to a disconnect from professional education and a failure to adapt to industrial technological advancements, thus hindering the effective cultivation of high-quality technical and skilled personnel [1].

Shenzhen is a core engine of the Greater Bay Area and a demonstration area for socialism with Chinese characteristics. It is a hub for industries such as electronics, intelligent manufacturing, new energy, and artificial intelligence. Leading

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companies and research institutions like Huawei, BYD, and Peng Cheng Lab are located here, actively developing "20+8" industry clusters, providing Shenzhen Polytechnic University with a unique advantage in vocational education. As one of the first national vocational undergraduate pilot schools, Shenzhen Polytechnic University aims to build a world-class vocational school with Chinese characteristics. Through collaboration with leading companies like Huawei and BYD, the university has established specialized industry academies, creating a strong foundation for industry-academia integration. In this context, the challenge lies in transforming the resources of the Greater Bay Area into second-classroom teaching resources, and achieving in-depth collaboration between the second classroom and professional education. This is a pressing issue that requires reform in vocational undergraduate practical teaching [2].

2 Overall approach and theoretical framework

This research is based on the practical realities of vocational undergraduate education at Shenzhen Polytechnic University. It adheres to the core principle of "industrial empowerment of teaching and practical reinforcement of learning". By breaking away from the traditional perception of the "second classroom" as an extension and periphery of formal education, it establishes a comprehensive, four-part educational system: "teaching objectives – content design – implementation path – evaluation and feedback". This creates a learning model characterized by "first classroom providing the foundation, second classroom strengthening practical application, and industrial resources providing support".

Firstly, the objective system: Aligning with the "20+8" industrial cluster in the Greater Bay Area, the system defines three key objectives: knowledge, skills, and competencies. This clarifies the role of the second classroom in expanding industrial knowledge, strengthening job skills, and cultivating innovation capabilities, ensuring clear teaching directions and measurable goals.

Secondly, the content design: Guided by professional teaching objectives, real-world projects, cutting-edge technologies, and essential job skills are transformed into modular, practical learning content. The content is tailored to specific disciplines, while also integrating general industry knowledge and specialized practical application.

Thirdly, the implementation path: Following the professional teaching objectives, a progressive learning module structure is established across different grade levels (basic vocational awareness, skill reinforcement in mid-level, and project innovation in higher levels). Simultaneously, the resources of schools, enterprises, and research institutions are integrated to generate teaching synergy.

Finally, evaluation and feedback: A comprehensive evaluation system based on "knowledge + skills + competencies" is established, incorporating student reports, project outcomes, company evaluations, and improvements in professional courses as evaluation indicators. This combines quantitative and qualitative measures to objectively assess the impact of the second classroom on professional education [3].

3 Practical exploration: Taking "Youth University Students' Innovation and Exploration in the Greater Bay Area" as an example

3.1 Comprehensive industry research and targeted resource alignment

At the outset of the project, the team adopted surveys, interviews, and other methods to gather feedback from industry experts, students, and key technical personnel. This helped to identify the specific practical teaching needs, skill gaps, and employment requirements for each specialty. The team then held workshops with over ten leading innovative companies in the Greater Bay Area to jointly determine the curriculum content, teaching methods, and assessment criteria. Collaborative teaching agreements were established between the schools and companies, clearly defining the respective responsibilities. Cutting-edge technologies, smart manufacturing, and artificial intelligence from companies like Huawei, BYD, and UChoose were integrated into the teaching resource library [4].

3.2 Developing modular content that balances general and specialized knowledge

Utilizing a four-pronged approach of "on-site visits and learning, technical seminars, practical project implementation, and on-site mentoring", we will organize a collection of practical teaching cases and operation manuals, developed jointly by professional teachers and enterprise technical experts. Tailored content will be developed for different professional fields: emphasizing production line training and quality control for manufacturing-related fields, and platform application, algorithm engineering, and data governance for information-related fields. This will achieve a seamless integration of "industry-wide knowledge and specialized practical experience".

3.3 Collaborative implementation between schools and enterprises

Innovative teaching methods are adopted. We employ a blended learning approach combining "dual-mentor system + project-driven + on-site instruction". Each student is paired with a school-based subject teacher and an enterprise technical mentor, wherein real industrial projects form the basis for immersive learning on the production floor. We encourage students to form cross-disciplinary teams to conduct innovative research, applying professional knowledge to real-world company challenges. We organize group visits to partner companies for students of different grades and disciplines, covering hundreds of students in total, gradually establishing a three-way synergy mechanism: "company deep involvement in teaching design, dual-mentor collaborative guidance, and student full participation in project research".

3.4 Comprehensive evaluation and system optimization

We utilize a comprehensive evaluation method incorporating "student ability testing, professional teacher assessment, enterprise practice evaluation, and teaching outcome demonstration". This assesses the effectiveness of the program across dimensions including knowledge acquisition, skill development, and professional ethics. By comparing student performance before and after the program with professional assessment results, we quantify the impact of the second classroom on professional development. Based on feedback, we establish a dynamic adjustment mechanism, regularly optimizing the curriculum, implementation process, and collaborative enterprise resources to ensure the teaching system remains aligned with industry advancements.

4 Results and key achievements

Following systematic implementation, the project has achieved significant results. Firstly, students have demonstrably improved their skills. Through practical learning, they have gained a comprehensive understanding of cutting-edge technologies, production processes, and technical standards in key industries, significantly enhancing their practical skills, cross-departmental collaboration abilities, and innovative capabilities. The results of numerous innovation projects have been showcased both within and outside the school. Secondly, the connection between practical learning and theoretical learning has been strengthened. The practical learning outcomes from the second classroom have directly benefited the first classroom, driving the alignment of professional courses with the latest technological advancements in the Greater Bay Area. The teaching methods have shifted towards "project-driven + on-site learning", achieving resonance between teaching and industry. Thirdly, the integration of industry and education has been continuously deepened. The school has established long-term, stable collaborations with numerous innovative enterprises, creating collaborative teaching bases, and establishing a sustainable platform for practical learning. Research indicates that the satisfaction rate among participants (teachers and students) is above 95%, with a significant increase in enthusiasm and professional identification.

The project yielded a series of teaching outcomes, including the development of the *Second Classroom Learning and Teaching Guide* and a collection of collaborative teaching case studies between the school and the enterprise. It also involved establishing an online- offline integrated platform to host learning resources, and proposing optimized plans for the integration of the "Second Classroom" with professional teaching, along with detailed implementation guidelines. This

provides a practical and replicable framework for reforming vocational undergraduate practical teaching.

5 Reflection and future outlook

Looking back at the research process, several issues still require ongoing attention. Firstly, the design of interdisciplinary learning content needs further refinement, aiming to cultivate tailored practical competencies for students from different specialties within a unified framework, thereby preventing uneven teaching outcomes. Secondly, the scientific evaluation of teaching effectiveness under the dual-course framework requires further improvement, with a need for a combined quantitative and qualitative indicator system. Thirdly, the rapid iteration of industries and technologies in the Greater Bay Area demands that the teaching system should establish a rapid response mechanism, enabling timely tracking of industrial technology updates and shifts in enterprise demands, thereby achieving dynamic adaptation to industry development. In the next phase, the project team will continue to deepen the construction of collaborative teaching mechanisms between schools and enterprises, expand the scope of cooperating companies and professional coverage, and promote the application of research results in similar vocational schools, contributing Shenzhen's experience and the Greater Bay Area solutions to the practical teaching reform of vocational undergraduate programmes [5].

In conclusion, this study is based on the practical implementation of curriculum reform within the vocational undergraduate programmes of Shenzhen Polytechnic University. It leverages the resources of the Greater Bay Area to explore an effective model of collaborative learning between the second classroom and professional education. The findings demonstrate that the "four-in-one" teaching model effectively addresses the issue of the second classroom being disconnected from professional education and industry, significantly improving the quality of talent cultivation. This provides a new approach for vocational undergraduate practical teaching reform, based on regional industry and centered around collaborative learning, which holds significant theoretical and practical value.

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Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

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