

Innovative Practice of Systematic Training of High-skilled Automobile Talents by School-enterprise Cooperation

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How to cite this paper: Zang, H. D. (2025). Innovative Practice of Systematic Training of High-skilled Automobile Talents by School-enterprise Cooperation. *Social Sciences and Humanities*, 2(3), 10–14. Print ISSN: 3104-4328; Online ISSN: 3104-4336. <https://doi.org/10.63313/SSH.2005>

Published: 2025-12-10

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Abstract

To address the challenges in cultivating highly skilled talents for the automotive industry's intelligent transformation, this study establishes a systematic talent development framework centered on "school-enterprise collaboration, curriculum-competition integration, and AI-assisted training". Tailored to the automotive sector's characteristics of "rapid technological iteration, rigorous practical demands, and strong innovation needs", the project partners with 12 leading automakers (including FAW-Volkswagen and Tuhu Auto Care) and provincial-level skills competition committees. Through five years of implementation, it has developed a "three-dimensional linkage" training model.

Keywords

School-enterprise collaboration; Course-competition integration; Talent cultivation

1. Introduction

Through the joint development of a dual-training base integrating "real production scenarios + virtual simulation" by schools and enterprises, corporate technical standards and competition assessment requirements are transformed into course resources. Leveraging a three-tier competition system (basic courses → specialized competitions → national competitions), the program achieves deep integration of curriculum instruction and skills competitions. An AI-assisted teaching platform (featuring virtual disassembly systems, fault diagnosis knowledge bases, and learning path planning modules) is developed to address traditional training challenges such as high equipment costs, significant risks, and inadequate personalized guidance.

Since its implementation, the program has trained over 1,800 students, who have won 23 national-level skills competition awards (including 5 first prizes in China) and 47 provincial-level awards, representing a 210% increase in awards compared to pre-reform levels.

The graduate employment rate has remained above 98% for three consecutive years, with the professional alignment rate rising to 89%, and employer satisfaction reaching 96%. The project's achievements have been reported three times by China Education News, and the relevant experience has been applied and promoted in 15 similar institutions, forming a replicable high-skilled talent cultivation plan that provides a practical example for the comprehensive reform of vocational education's "position-course-competition-certification" system.

2. Key Teaching Challenges and Solutions

2.1. Core Teaching Issues

Superficial School-Enterprise Collaboration: Disconnection Between Practical Training and Industry Needs Under the traditional model, school-enterprise partnerships often remain at the level of "equipment donations by enterprises and student visits for internships." This results in difficulties in integrating corporate technical standards and actual job requirements into teaching content, creating a "last-mile" gap between students' skills and the practical demands of 4S stores and repair enterprises (for instance, coverage of new technology modules like high-voltage system maintenance for new energy vehicles is less than 30%).

The disconnect between curricula and competitions, coupled with a lack of systematic skill development, creates a gap in training effectiveness. While classroom instruction emphasizes theoretical knowledge, competition preparation often relies on last-minute cramming, with no proper integration between the two. On one hand, students' classroom learning fails to align with competition evaluation criteria (for instance, the traditional "Automotive Fault Diagnosis" course only covers 52% of competition standards). On the other hand, competition achievements rarely translate into teaching resources, resulting in an inefficient training model where "a few participate while most remain spectators."

The "limited availability" of practical training resources makes personalized cultivation challenging. Automotive training equipment is prohibitively expensive (a single new energy vehicle training bench costs over 200,000 yuan), with rapid consumable depletion. Institutions commonly face issues such as "less than 40 hours of per-student training time per semester" and "inadequate training for high-risk operations (e.g., high-voltage testing)." Additionally, teachers struggle to accurately identify students' skill gaps through traditional teaching methods, resulting in less than 20% coverage of personalized guidance.

2.2. Solution

Establish a "dual-system" collaborative education mechanism between schools and enterprises to bridge industry demands and teaching practices. Jointly develop a "dual-qualified" teaching team: Enterprise technical experts (e.g., 4S store technical

directors) collaborate with faculty to form course teams, co-developing 8 core courses including "Intelligent Connected Vehicle Maintenance," and transform real-world maintenance cases (e.g., Volkswagen ID. series battery failures) into teaching projects.

Establishing a 'factory-in-school' training base: Collaborating with partner enterprises to build an immersive training workshop (1,500 m²), equipped with cutting-edge facilities including new energy vehicles and intelligent diagnostic systems. Students rotate through real-world maintenance tasks (averaging over 300 vehicle repairs annually).

The "staircase" enterprise internship is implemented in three stages: "cognitive internship (first year) → on-the-job internship (second year) → top-post internship (third year)". The enterprise participates in the whole process of the talent training program, and the internship assessment results are included in the credit system.

Promote the "course-competition integration" teaching reform to establish a systematic skills training framework. The competition standards were reverse-engineered into course modules: six major components of the "Automotive Inspection and Maintenance" event in the National Vocational College Skills Competition (including engine systems, chassis systems, etc.) were decomposed into course units. Five "competition-course integration" textbooks were developed, with "Automotive Electronic Control System Maintenance" being recognized as a provincial first-class course.

Establish a "three-tier progressive" competition training system: Basic Level: Offer the "Automotive Maintenance Fundamentals Competition" to all students (covering freshmen with 100% annual participation rate); Intermediate Level: Select outstanding students to form competition training teams for specialized skill development (aligned with provincial competitions, averaging 200 trainees annually); Elite Level: Implement a dual mentorship system ("corporate mentors + campus coaches") for national competition participants, conducting technical breakthroughs (e.g., optimizing rapid fault diagnosis algorithms for new energy vehicles).

The teaching resource library for converting competition results into educational materials compiles award-winning projects (e.g., "Fault Diagnosis of Power Loss in Hybrid Electric Vehicles") into 120 teaching cases and develops 6 virtual simulation training modules for daily teaching reuse.

Develop an "AI + Training" platform to deliver personalized and efficient training. Virtual disassembly and fault simulation system: Using VR/AR technology, students can practice high-risk, high-cost operations (e.g., high-voltage system inspection) repeatedly through virtual disassembly scenarios of core automotive components (e.g., transmissions, battery packs), extending training hours to 120 hours per semester.

The Intelligent Fault Diagnosis Assistant System integrates a knowledge base of over 5,000 typical fault cases. When students input fault symptoms, the system automatically provides diagnostic approaches, repair procedures, and video tutorials, boost-

ing the diagnostic accuracy rate from 65% before the reform to 92%.

Big Data Analysis Platform for Learning Behaviors: It tracks students' practical training data (e.g., error rates, task completion time), generates personalized learning reports, and enables teachers to adjust teaching strategies (e.g., adding targeted training for weak points like CAN bus communication failures).

3. Innovation point

We pioneered the "Three-Dimensional Synergy" training model, achieving deep integration of school-enterprise collaboration, curriculum-competition synergy, and AI application. This model breaks through the limitations of traditional "single-dimensional" reforms by establishing a systematic training framework: "school-enterprise collaboration lays the foundation, curriculum-competition synergy enhances skills, and AI assistance boosts efficiency." Specifically, school-enterprise collaboration addresses "industry demand alignment," curriculum-competition synergy tackles "systematized skill training," and AI assistance resolves "resource constraints and personalized guidance." These three elements form a closed loop (e.g., enterprise technical needs → competition topics → curriculum integration → AI-enhanced training → student skill attainment → enterprise service), achieving a 40% efficiency improvement over similar projects.

Developing an "integrated virtual-real" AI training system to address the challenges of high-cost and high-risk practical training. As China's first institution to deeply integrate AI technology into automotive maintenance training, the system achieves 60% reduction in equipment investment costs through virtual simulation (saving an average of 800,000 yuan in annual training expenses per school), 50% reduction in fault diagnosis time via intelligent systems, and personalized teaching through big data analytics. The system has secured 2 national invention patents and 5 software copyrights, with its "New Energy Vehicle Virtual Training Platform" recognized as a model case of vocational education informatization by the Ministry of Education.

Establish a "dynamic update" curriculum mechanism to synchronize teaching content with industrial technology advancements. Through the school-enterprise joint committee (comprising corporate technical directors, competition judges, and faculty), a "technology seminar" is held each semester. The curriculum is dynamically adjusted based on automotive industry innovations (e.g., 800V high-voltage platforms, intelligent driving domain controllers) and competition standard updates (e.g., the 2024 national competition's addition of "battery thermal management system maintenance" module), achieving an average annual update rate of 35%. This ensures students' skills remain aligned with industry frontiers, reducing the lag compared to traditional courses by 80%.

4. Summary

To address the challenges in cultivating highly skilled talents for the automotive in-

dustry's intelligent transformation, this initiative establishes a systematic talent development framework centered on "school-enterprise collaboration, curriculum-competition integration, and AI-assisted training." Tailored to the automotive sector's characteristics of "rapid technological iteration, rigorous practical demands, and strong innovation needs," the project has developed a "three-dimensional linkage" training model over five years. This model effectively resolves traditional training issues such as "high equipment costs, significant risks, and inadequate personalized guidance."

Acknowledgements

I would like to express my gratitude to the members of the research team for their strong guidance in this study. Project "2021 Suzhou Industrial Vocational Technology Institute Teaching Innovation Team", Project Number: 2021JXTD004.

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