Research and Practice on a New Path of Industry-Education Integration for the Automotive Intelligent Technology Major in Higher Vocational Colleges Based on the "1+X" Certificate System with Industrial Colleges as the Carrier

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Abstract: This paper focuses on research into industry-education integration and "curriculum-certificate integration" for the Automotive Intelligent Technology major in higher vocational colleges. It analyzes the current state of industry-education integration in vocational education domestically and internationally. Developed countries exhibit distinct characteristics with deep enterprise involvement across all stages, while China is continuously advancing under the "1+X" certificate system[1-2]. This study identifies issues in "curriculum-certificate integration" for the Automotive Intelligent Technology major, including loose articulation between talent cultivation programs and certificates, low integration of certificates, fragmented teaching standards, insufficient teaching resources, lack of integration platforms, and an underdeveloped cultivation mechanism for "dual-qualified" teachers. Consequently, it proposes utilizing the Intelligent Automotive Industry College jointly established with Guangxi Automobile Group as a carrier to explore a "dual-entity" collaborative talent cultivation model. Using the "X" certificate as a link to promote standard alignment, it aims to construct a broad-based, modular, and shareable curriculum system, comprehensively advance "curriculum-certificate integration," facilitate mutual recognition between enterprise technical certificates and vocational skill level certificates, enhance talent cultivation quality, adapt to the demands of the intelligent transformation in the automotive industry, and promote the development of vocational education alongside industrial upgrading.

1. Introduction

Currently, international research on vocational education primarily focuses on qualification frameworks and vocational education models, with some case studies on certificate certification implementation. Domestic research mainly concentrates on specific aspects of industry-education integration under the "1+X" certificate system, such as practical training base construction and teacher training, but often overlooks new carriers for integration. Research on pathways for integrating job standards, professional teaching standards, and vocational standards remains insufficiently deep[3-4].

Based on documents such as the State Council General Office's Opinions on Deepening Industry-Education Integration and the Ministry of Education General Office and Ministry of Industry and Information Technology General Office's Notice on Issuing the "Guidelines for Modern Industrial College Construction (Trial)", and integrating the spirit of the "Vocational Education 20 Articles," this study will take industrial colleges as the carrier and the "1+X" certificate system as the link to explore effective means for integrating higher vocational professional teaching standards and vocational standards, thereby enriching the theory of new paths for industry-education integration based on the "1+X" certificate system[1-2].

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2. Current State of Industry-Education Integration in Vocational Education Domestically and Internationally

2.1. Developed Countries Exhibit Distinct Characteristics in Industry-education Integration

Germany: Renowned for its distinctive "Dual System" (Duales System), schools and enterprises form "dual" entities engaged in deep collaboration throughout the talent cultivation process. Students learn theory at institutions and practice skills in enterprises. Upon graduation and passing examinations, they obtain both academic qualifications and vocational qualification certificates. Industry associations play a strong leading role in setting standards and norms, effectively promoting precise industry-education alignment.

Modular course design offers flexibility, allowing students to choose courses based on their needs. Enterprises are extensively involved in course design, practical training, and other aspects, collaborating with schools to develop skilled professionals suited to market demands.

United States: Community colleges collaborate closely with enterprises, designing professional courses and training plans based on industry needs. Industry and enterprises lead the construction of vocational standards, ensuring education aligns with industry realities. Practical teaching occurs in authentic enterprise settings, where students participate in projects under the guidance of enterprise mentors, accumulating practical experience to integrate rapidly into the workplace upon graduation.

United Kingdom: Pioneered a mature system equating vocational qualification certificates with academic certificates. Vocational education courses are tightly centered around qualification certificates. Industry and enterprises deeply participate in curriculum development, teaching, and assessment. The modern apprenticeship system perfectly integrates work and learning, with enterprises providing practical positions and mentorship, while training institutions or colleges provide theoretical instruction.

In summary, developed countries exhibit several common features in industry-education integration. Enterprises are deeply involved in all key stages of vocational education, leaving a strong imprint from curriculum design and teaching implementation to assessment evaluation, ensuring educational content is closely linked to industry realities. They also emphasize constructing a well-structured vocational education system, achieving effective articulation and integration between vocational education, general education, and higher education through various forms, providing students with diverse development pathways. Furthermore, they actively explore diverse industry-education integration models, such as modern apprenticeships and dual systems, enabling students to accumulate practical experience and vocational skills during their studies. This cultivates high-quality professionals highly aligned with market demands and industry standards, powerfully driving the high-quality development of their national vocational education systems and the stable progress of their economies and societies.

2.2. Domestic Industry-education Integration Work is Continuously Advancing

Driven by the "1+X" certificate system, domestic industry-education integration work is flourishing and deepening. Huang Guanshan from the Automotive major at Zhuhai City Polytechnic actively explored constructing an industry-education integrated practical teaching base for higher vocational automotive majors, achieving multi-faceted alignment through curriculum system reform and evaluation system construction to enhance talent cultivation quality[5]. Guided by relevant concepts, Wang Honglei implemented modern apprenticeship cultivation, establishing a multi-dimensional system to tightly connect the IoT Application Technology major with the industrial chain, achieving integration across multiple domains[6]. Xu Dali pointed out that most vocational colleges leverage the industry-education integration model, implementing the "1+X" certificate system. Through multifaceted efforts, they not only stimulate student potential and enhance comprehensive student quality but also promote the construction of practical training bases and supply enterprises and society with a large number of outstanding talents. This demonstrates the significant achievements and broad development prospects achieved through multi-dimensional active exploration and practice in domestic industry-education integration work[7].

3. Significance of Implementing "Curriculum-Certificate Integration" in the Higher Vocational Automotive Intelligent Technology Major

With the rapid development of technology, the automotive industry is accelerating into the intelligent era, leading to continuously rising demand for professionals in China's automotive intelligent technology field. Since the implementation of the "1+X" certificate system in 2019, vocational colleges nationwide have responded actively, closely following industry frontiers, and fully engaged in transforming talent cultivation models. They vigorously promote the improvement of teaching standards, restructuring of curriculum systems, building "dual-qualified" teaching teams, constructing practical teaching bases, and updating talent cultivation programs. For the Automotive Intelligent Technology major, the industry's rapid evolution presents new requirements for technical and skilled talents serving on the front lines of automotive intelligent technology. In a skill-based society, strengthening the core competitiveness of graduates from this major—equipping them with both profound professional knowledge and outstanding practical abilities—is crucial. Practical experience shows that students possessing both academic certificates and vocational skill certificates integrate more rapidly into professional roles upon entering the workplace. Therefore, deeply integrating the "1+X" vocational level certificate standards into the talent cultivation program for the Automotive Intelligent Technology major is critically important. This not only significantly enhances the vocational core competitiveness of students, helping them stand out and gain an advantage in the job market, but also contributes to building a skill-based social ecosystem where "academic qualifications + skills" complement and develop synergistically. It precisely cultivates a high-quality talent echelon meeting the needs of the automotive intelligent technology industry, powerfully propels the entire industry towards high-quality development, realizes the deep integration and positive interaction between education and industry, and highlights the unique value and far-reaching influence of implementing "curriculum-certificate integration" in the Automotive Intelligent Technology major within the context of new-era vocational education and industry development.

4. Analysis of the Current State of "Curriculum-Certificate Integration" in the Higher Vocational Automotive Intelligent Technology Major

4.1. Loose Articulation Between the Professional Talent Cultivation Program and "x" Certificates

The talent cultivation program is a key guiding document for categorizing and cultivating talents based on societal needs. It encompasses various elements within the professional teaching standards, such as the industry fields involved, graduate employment trends, occupational categories, cultural literacy, professional skills, innovation and entrepreneurship, and vocational skill level certificates. Currently, the Automotive Intelligent Technology major is in the pilot phase of the "1+X" certificate system, with limited corresponding "X" certificate types available. For instance, they may focus only on a few specific skill areas, failing to comprehensively cover the complex skill requirements of the automotive intelligent technology field. Moreover, the supporting systems for these vocational skill level certificates are incomplete, lacking mature training processes and scientifically reasonable assessment mechanisms. Additionally, there is a disconnect between the "X" series certificates and the talent cultivation program; the two operate like "separate skins" (liang zhang pi). Integration between the curriculum setup and certificate requirements is insufficient, necessitating significant effort to advance "curriculum-certificate integration" to better adapt to the industry's diversified demands for Automotive Intelligent Technology professionals.

4.2. Low Integration Between Academic Certificates and "X" Certificates

The Automotive Intelligent Technology major is highly practice-oriented, with stringent requirements on students' practical operational abilities. Graduates often work in frontline positions at automotive intelligent technology-related enterprises, primarily responsible for the installation, debugging, maintenance, and fault detection of automotive intelligent systems. Upon joining an

enterprise and being assigned to a position, graduates need to obtain corresponding on-the-job vocational qualification certificates. This compels enterprises to invest substantial human, material, and time resources in training newly hired graduates to help them acquire the necessary qualifications. This situation indicates a fundamental separation between the current academic certificates for the Automotive Intelligent Technology major and the relevant "X" certificates. Schools primarily conduct teaching around the academic certificate management system; students obtain their graduation certificates by completing the required course credits. In contrast, "X" certificates are assessed and evaluated by third-party enterprise institutions. Effective integration between skill credits and course credits has not yet been achieved between the two systems. Consequently, the integration level between the professional academic certificate and the "X" certificate is low, failing to meet the demand of the automotive intelligent technology industry for high-quality compound talents and hindering students' competitiveness in the job market.

4.3. Fragmentation Between Professional Teaching Standards and "X" Vocational Skill Level Standards

Currently, the setting of curriculum standards for the Automotive Intelligent Technology major primarily focuses on meeting the needs of academic education, resulting in a serious disconnect from the practical requirements of job-related vocational skills. Teaching content often follows a knowledge-based logic, with a high proportion of theoretical knowledge and a severe shortage of practical content, lacking close correlation with "X" vocational skill level standards. During the professional development process, there is a lack of deep participation and effective guidance from industry enterprises. This situation makes it difficult for graduates to adapt to the actual needs of social production and employers, hindering efforts to promote a skill-based society and the development of the automotive intelligent technology field. It fails to provide strong talent support for industrial development, thereby affecting the high-quality development of the entire industry and the effective implementation of technological innovation.

4.4. Insufficiency of "Curriculum-Certificate Integration" Teaching Resources

Due to its integrated theory-practice nature, the Automotive Intelligent Technology major places high demands on the timeliness and diversity of teaching resources. The key to resource development lies in resource dimensions, content, and development methods. However, current teaching resource development for this major primarily relies on the curriculum system and standards, guided by regulations and theoretical knowledge frameworks. Resources are predominantly presented through printed textbooks, with skill demonstrations relying solely on textual descriptions, making it difficult for students to understand and master the content. Regarding the intrinsic construction of teaching resources, textbooks are mostly developed from a knowledge-based perspective, with singular formats biased towards knowledge-based academic education. This results in poor alignment with "X" certificate standards, obstructing "curriculum-certificate integration." In terms of practical teaching base construction, there is an insufficient number of industry-education integrated bases jointly built by schools and enterprises. Teachers lack practical opportunities, and student internship conditions are poor. These factors severely constrain the improvement of talent cultivation quality, fully exposing the problem of scarce "curriculum-certificate integration" teaching resources. This urgently requires improvement through innovative resource development models and strengthened deep school-enterprise cooperation to meet the needs of professional development and talent cultivation.

4.5. Lack of a "Curriculum-Certificate Integration" Platform

With the deepening implementation of the "1+X" certificate system in higher vocational education, many institutions offering the Automotive Intelligent Technology major have adopted it. However, numerous problems have emerged during actual implementation. Most institutions have fallen into the trap of "teaching to the test," where daily classroom teaching content is severely disconnected from the content of "X" certificates. The key points within "X" certificates receive insufficient attention in regular classroom teaching, with intensive training only occurring shortly

before vocational skill level certification assessments. This practice completely deviates from the original intent of the "1+X" certificate system. Simultaneously, daily teaching modules are set up in isolation from each other. While students earn credits after completing skill modules, the absence of a corresponding data management platform results in a complete lack of correlation between course teaching content and "X" certificate assessment standards, leaving the two in a state of total separation. Student skill certification and course assessment are unrelated, significantly hindering the full effectiveness of vocational education. This is detrimental to cultivating high-quality skilled talents that meet the needs of the automotive intelligent technology industry and fails to realize the positive role of "curriculum-certificate integration" in enhancing talent cultivation quality.

4.6. Cultivation Mechanism for "Dual-Qualified" Teachers Needs Improvement

The Automotive Intelligent Technology major encompasses both theoretical courses and practical teaching courses, requiring professional teachers to possess not only solid theoretical knowledge but also strong practical abilities. However, the current level of school teachers is uneven. Many teachers enter teaching positions directly after university graduation, possessing minimal understanding of the basic job skills in the automotive intelligent technology industry. Some even resort to reading verbatim from textbooks during practical lessons. Concurrently, enterprise part-time teachers face their own issues. While they possess rich practical experience, they often lack experience in theoretical teaching and basic classroom teaching skills, leading to unsatisfactory teaching outcomes. Both full-time and part-time teachers, to some extent, lack the capability to teach the Automotive Intelligent Technology major effectively under the "1+X" certificate system. This situation seriously constrains the intrinsic development of the major and is unfavorable for cultivating high-quality talents adapted to the development needs of the automotive intelligent technology industry. Therefore, improving the cultivation mechanism for "dual-qualified" teachers is imperative.

5. Construction Path for "Curriculum-Certificate Integration" in the Higher Vocational Automotive Intelligent Technology Major

5.1. Basic Approach

Based on the Intelligent Automotive Industry College jointly established with Guangxi Automobile Group, collaborate with Guangxi Automobile Group to jointly research major setup, jointly design talent cultivation programs, jointly develop courses, jointly compile teaching materials, jointly form teaching teams, jointly build practical training and internship platforms, and jointly formulate talent cultivation quality standards, comprehensively advancing "curriculum-certificate integration."Programs align with the standards of both enterprise technical certifications and the vocational skill level ("X") certificates. Meanwhile, a pilot program for the Intelligent Connected Vehicle Testing and Calibration "X" Certificate will be conducted within the Automotive Intelligent Technology major. Those who pass the assessment can obtain both the vocational skill level certificate and the Guangxi Automobile Group enterprise technical level certificate. Leveraging the Intelligent Automotive Industry College as a platform and the "1+X" certificate system as a bridge, we will deepen industry-academia integration. Schools and enterprises will collaborate to cultivate industry-recognized, enterprise-welcomed inter-disciplinary technical talents.

5.2. Overall Framework

By using the Industrial College as a base, we will meet the regional high-end industry's need for interdisciplinary skilled talents. We will introduce new technologies and standards from the industry and incorporate "1+X" certificate requirements to create training programs with enterprises. This includes building a "dual-entity" education model.

To address the demands of the job market, we will build a flexible, modular curriculum to strengthen students' foundational, core, and innovative skills.

The "X" certificate will help align teaching standards with vocational and industry standards, improving training quality. We will build a shared resource library with enterprises, containing online courses, training packages, and practical textbooks for both students and professionals.

Finally, we will promote "curriculum-certificate integration" to enable mutual recognition between different types of certificates.

5.3. Utilizing the Industrial College as the Carrier for Deepening Industry-Education Integration to Explore the "Dual-Entity" Collaborative Talent Cultivation Model

As a crucial bridge connecting education and industry, the industrial college holds a core position in deepening industry-education integration. Its development direction is closely aligned with the diverse demands of regional high-end industries for compound technical and skilled talents. With the rapid development of technology, new technologies, processes, and specifications continuously emerge in the industrial sector. The industrial college proactively introduces these cutting-edge elements into teaching practice. Simultaneously, it deeply integrates the requirements of the "1+X" certificates, injecting new vitality into talent cultivation.

Regarding school-enterprise cooperation, both parties participate deeply and comprehensively in formulating talent cultivation programs. Schools leverage their educational resource advantages to lay a solid theoretical foundation for students. Enterprises contribute their expertise in practical fields, integrating authentic industrial environments, work processes, and practical experience into teaching content. Through this approach, the exploration and establishment of a "dual-entity" collaborative talent cultivation model for compound technical and skilled talents is realized.

Within this model, the roles of the school and enterprise are clearly defined and synergistic. School teachers and enterprise experts jointly form teaching teams, co-develop curriculum systems to ensure course content reflects both systematic professional knowledge and targeted practical skills. During the teaching process, enterprises provide internship and practical training bases and real projects, allowing students to hone their skills in authentic industrial settings and cultivate problem-solving abilities. Concurrently, enterprise experts regularly conduct lectures and guide practical teaching at the school, keeping students informed about the latest industry trends and actual enterprise needs. The school, meanwhile, is responsible for students' foundational knowledge education, comprehensive quality cultivation, and learning process management, providing holistic support for students' career development. This "dual-entity" collaborative talent cultivation model breaks down the barriers between traditional education and industry, opening a new path for cultivating high-quality talents adapted to industrial development needs.

5.4. Using the "X" Certificate as a Link to Promote Standard Alignment and Improve Compound Talent Cultivation Quality

In the context of rapid industrial development, to better meet the demands of the industrial chain and diverse job clusters, there is a need to construct a scientific, reasonable, and forward-looking curriculum system. This system is characterized by being broad-based, modular, and shareable. "Broad-based" refers to providing students with extensive and solid foundational knowledge covering various fields related to the profession, including but not limited to basic theory, general technology, and humanities literacy, enabling students to have broad development space and strong adaptability upon entering the workplace.

"Modular" curriculum design divides the entire curriculum system into multiple relatively independent yet interconnected modules based on different functional and skill requirements. These modules can be flexibly adjusted and combined according to industrial development dynamics, such as Basic Skills Modules, Professional Core Modules, and Extension & Enhancement Modules. The Basic Skills Modules focus on cultivating students' fundamental operational and comprehension abilities within the professional domain. Professional Core Modules provide in-depth training for the core competencies required by key positions, enabling students to master essential job skills. Extension & Enhancement Modules concentrate on cultivating students' innovation abilities for technological advancement, encouraging them to break through traditional thinking and explore the

application of new technologies and methods in practical work.

The "Shareable" curriculum system emphasizes resource integration and sharing. Whether between different majors within the school or between schools and enterprises, knowledge, skills, and practical experience can be exchanged through this system. This sharing model helps break the limitations of educational resources, broadens students' horizons, and promotes interdisciplinary and cross-domain knowledge fusion. The "X" certificate plays a vital linking role within this curriculum system. Using the "X" certificate as the basis and guide, it promotes the effective alignment of professional teaching standards, vocational standards, and job position standards. Professional teaching standards define the teaching objectives, content, and requirements for professional courses within school education. Vocational standards regulate the knowledge, skills, and literacy required for a specific occupation from an industry-wide perspective. Job position standards detail the specific skills and competency requirements for each job role. Through the "X" certificate as the bridge, these three are tightly integrated, achieving seamless articulation from school education to career development and specific job performance.

In the actual teaching process, teachers optimize and adjust teaching content based on the skills and knowledge requirements covered by the "X" certificate. Course assessment and evaluation mechanisms are also aligned with the assessment standards of the "X" certificate, ensuring that upon completing course studies, students also meet the conditions for obtaining the "X" certificate. Thus, upon graduation, students possess not only an academic certificate but also an industry-recognized "X" certificate. Their comprehensive abilities are significantly enhanced, effectively improving the quality of compound talent cultivation and enabling the supply of more high-quality talents that meet industrial needs.

5.5. Comprehensively Advance "Curriculum-Certificate Integration" to Promote Mutual Recognition and Interchangeability of Enterprise Technical Certificates and Vocational Skill Level Certificates

This initiative aims to fully integrate the vocational technical talent cultivation and training system for automotive intelligent technology, enabling it to meet the dual needs of academic education and vocational training. To achieve this goal, we actively collaborate with automotive-related enterprises to jointly build a batch of high-quality, school-enterprise co-constructed and shared teaching resource repositories for professional groups. This repository includes rich and diverse online high-quality courses closely centered on the core knowledge and cutting-edge applications of automotive intelligent technology, providing detailed and in-depth explanations on topics ranging from communication principles for intelligent connected vehicles to algorithm design for autonomous driving systems. Simultaneously, targeted training resource packages are meticulously developed, containing numerous practical cases, operation guides, and simulation projects to help students and trainees better apply theoretical knowledge to practical operations. Furthermore, effort is dedicated to compiling work manual-style, loose-leaf teaching materials known for their flexibility and practicality, allowing content to be promptly adjusted according to technological updates and market changes in the automotive intelligent technology industry. Focusing on "curriculum-certificate integration" as the key point, we delve into the content and requirements of enterprise technical level certificates and vocational skill level certificates. By optimizing curriculum design, assessment standards, and other measures, we aim to achieve mutual recognition and interchangeability between the two systems in terms of knowledge structure and skill requirements, cultivating more comprehensively capable, high-quality talents for the automotive intelligent technology field.

6. Conclusion

The "1+X" certificate system is highly practical and forward-looking. It is a key measure for China to address industrial upgrading and alleviate structural contradictions in technical and skilled talents. It is also an important pathway to accelerate the construction of a skill-based society, deepen industry-education integration, reform vocational education models, and achieve

"curriculum-certificate integration" in vocational education[1-2]. As the core segment of the intelligent development of the modern automotive industry, the automotive intelligent technology sector exemplifies the development trend of high-tech, intelligent industries. Introducing the "1+X" vocational skill level certificate standards into the talent cultivation process of the Automotive Intelligent Technology major and implementing related curriculum integration measures not only benefits the enhancement of professional talent cultivation quality but also opens new perspectives for the construction and development of this major. It enables the major to better adapt to the new talent requirements driven by the intelligent transformation of the automotive industry.

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