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Research on the innovative path of practical teaching in college racing under the background of "double creation": a case study of Geely University of China

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Abstract. Based on the strategic needs of "double innovation", this article takes Geely College as a typical case and combines the high-quality resources of Tianfu International Circuit to systematically explore the innovative path of practical teaching in college motorsports. By constructing a "three-level progressive" practice platform, implementing a "credit exchange" incentive mechanism, establishing an integrated training system of "industry university research transfer", and deeply integrating the facilities, events, and cooperation resources of Tianfu International Circuit, we have innovatively formed a "competition education integration" education paradigm with Geely characteristics. Empirical research has shown that this model has significant effects in improving students' engineering practice ability, innovation and entrepreneurship literacy, and industry integration ability, providing replicable experience samples for practical teaching reform in applied universities.

Keywords: motorsport, practical teaching, integration of industry and education, credit exchange

1. Introduction

Against the backdrop of the deepening of the national strategy of "mass entrepreneurship and innovation", the practical teaching system in universities is facing dual challenges of industrial upgrading and technological innovation [1]. Geely College, relying on the industrial advantages of Geely Holding Group, innovatively incorporates motorsports into the practical teaching reform system, and collaborates with Tianfu International Circuit to build an educational platform that integrates "technological innovation engineering practice achievement transformation". By constructing immersive learning environments such as new energy vehicle training rooms and digital production lines for automobiles, we aim to deeply integrate F1 standard track practice with classroom teaching. This article is based on the theoretical framework of the "Three Platforms" construction proposed by Professor Jin's team [2], combined with the practical exploration of Geely College, to systematically study the deep integration mechanism of motorsports and innovation and entrepreneurship education, providing practical reference for the reform of engineering education in the new era.

2. Current situation of practical teaching of racing in universities under the background of "double innovation"

2.1. There are structural contradictions in the management mechanism

As The research results indicate that traditional racing practice teams generally face structural contradictions in their management mechanisms, manifested in the prominent phenomenon of blurred team positioning, and some participating teams have unclear technical research directions due to unclear division of responsibilities. The division of labor among members exhibits extensive characteristics, and insufficient professional matching affects collaboration efficiency. There is a risk of discontinuity in the inheritance of technology, and the low retention rate of technical documents restricts the accumulation of experience and iterative development. This systemic management deficiency has become a core bottleneck restricting the sustainable development of the team.

2.2. The ability development system lags behind the industry demand

The construction of the curriculum system related to intelligent connected vehicles in current universities is still in the exploratory stage. Most universities have not yet formed independent specialized curriculum systems, and practical activities are mostly based on traditional course modules such as “Automotive Theory” and “Automotive Construction”. Some universities have attempted to integrate competition projects with courses (such as Cruise software simulation, electric equation vehicle model design, etc.), but due to limitations in class hours and teaching conditions, practical engineering problems still need to be simplified. The traditional curriculum system lacks adaptability to the requirements of intelligent connected technology, resulting in a lack of systematic practice carriers and difficulty in meeting the training requirements of interdisciplinary engineering abilities (such as artificial intelligence, communication technology, hardware and software integration) for intelligent connected vehicles [3].

Industry feedback shows that due to insufficient cross disciplinary courses and a disconnect between practice and cutting-edge technology, there is a gap between graduates' practical abilities and job requirements in fields such as electronic control system development and vehicle integration, requiring a long adaptation period. This phenomenon is closely related to the shortage of composite talents in the field of intelligent connected vehicles (expected to have a net gap of 37,000 people by 2025) and the current curriculum system lagging behind the development of the industry.

2.3. The teacher structure shows an imbalanced trend

There is a significant structural imbalance in the current faculty configuration, manifested as insufficient depth of participation of enterprise mentors in practical teaching, mostly limited to short-term guidance. The proportion of “dual teacher” teachers with both industry research and development experience among full-time teachers on campus is relatively low, making it difficult to effectively bridge the “theory practice” gap. Although the proportion of “dual teacher” teachers in higher education institutions has increased, there is still a scarcity of composite teachers who truly possess theoretical innovation and practical abilities. Moreover, enterprise mentors often find it difficult to participate in teaching on a regular basis due to imperfect school enterprise cooperation mechanisms and professional title barriers. This contradiction has led to a lag in the updating of the curriculum system, and it is urgent to establish a cross disciplinary teaching team composed of enterprise technical experts, subject leaders, and innovative mentors through the joint recruitment of “research-oriented teachers” by schools and enterprises, reform of the teacher evaluation mechanism, and the formation of a teacher support system that links “academic frontiers-industry demand-technological innovation.”

2.4. Influence of patent orientation on scientific research and innovation ability

Patent orientation has a significant and far-reaching influence on the cultivation of university students' scientific research and innovation ability. This orientation not only provides a guarantee for scientific research and innovation from the institutional level, but also lays a solid foundation for students' ability cultivation at the practical level [3].

The promotion role of patent orientation in the transformation and application of scientific research and innovation achievements can not be ignored. Under the traditional scientific research mode, the innovative achievements of many university students often stop at the laboratory or academic papers, which is difficult to transform into the actual social productivity. That is changing, driven by a patent orientation. More and more colleges and universities begin to pay attention to students' patent application and achievement transformation work, and actively build a bridge for students to cooperate with the industry. Through this cooperation, students can not only transform their innovations into products or services with market value, but also exercise their practical ability, teamwork ability and market insight in the process. The improvement of these abilities will undoubtedly further enhance the students' scientific research and innovation ability, so that they can go further and more stable on the future scientific research road.

Patent orientation also helps to cultivate students' intellectual property awareness and legal awareness. In the process of patent application and protection, students need to understand and master the relevant intellectual property laws and regulations, and learn how to use legal weapons to safeguard their legitimate rights and interests. This promotion of legal awareness will not only help students to avoid the risk of infringement in scientific research and innovation activities, but also lay a solid foundation for them in their future career.

2.5. Feedback of scientific research and innovation ability on patent orientation

The improvement of college students' scientific research and innovation ability is not only a reflection of individual academic growth, but also a direct feedback on the implementation effect of patent-oriented strategy. This feedback effect is reflected in two aspects: one is to promote the generation of high-quality patents, the other is to promote the improvement and optimization of the patent system.

To promote the emergence of high-quality patents, the improvement of students' research and innovation ability means that they can come up with more original and practical ideas in the research process. These ideas are translated into competitive

technological achievements through patent applications and protection. These high-quality patents not only reflect the students' innovation strength, but also provide a strong support for the patent-oriented implementation. For example, in some universities, students have successfully developed new technologies with independent intellectual property rights through participating research projects and applied for patent protection. These patent achievements not only bring honor to the school, but also inject new impetus into the development of related industries.

In the process of improving their scientific research innovation ability, college students will also participate in more exchanges and cooperation with external entities through various scientific research projects and practical activities. Such communication and cooperation can not only broaden students' horizons and enhance their practical ability, but also provide more opportunities and channels for the transformation and application of patents. Through these opportunities and channels, students can transform their scientific research achievements into actual productivity and make greater contributions to the development of social economy. At the same time, this process of transformation and application is also an important test and feedback of the implementation effect of patent-oriented strategy.

The improvement of college students' scientific research and innovation ability has an important feedback effect on the patent orientation. This feedback effect is not only reflected in promoting the generation of high-quality patents, but also reflected in promoting the improvement and optimization of the patent system. Therefore, we should fully realize the importance of this feedback effect, and promote the in-depth implementation and sustainable development of patent-oriented strategy by continuously improving students' scientific research and innovation ability.

3. Innovative practice in racing practice teaching at geely college

Geely College, relying on the industrial advantages of Geely Holding Group, has jointly established a forward-looking practical teaching system for motorsports with Mingtai Group, forming an innovative training model of “theoretical teaching + practical training base + competition practice” [4].

This system achieves a closed-loop ecosystem of “industry raises questions, education incubation plans, and arena verification value” through co building courses, forming teams, and sharing platforms, promoting deep integration between talent cultivation and industry demand. In the broader cultivation of automotive professionals, Geely College takes the “big cycle small cycle professional circle” three ring resonance curriculum system as the core, and sets up modules of “subject basic courses + professional core courses + professional direction courses + comprehensive practical courses” to strengthen students’ general, specialized, and sustainable development abilities.

At the same time, through the construction of “double hundred plan”, “double teachers and double abilities” teachers, the joint construction of practical training bases by schools and enterprises (such as F1 standard track, industrial Internet laboratory) and the cultivation of “order classes”, an applied talent cultivation mechanism with deep integration of production and education has been formed [5].

3.1. Building a “three stage progressive” practice platform system

Innovatively build a three-level practical platform of “foundation improvement innovation” (as shown in Table 1), forming a hierarchical and spiral training architecture. This system follows the cognitive laws of engineering education and scientifically plans the advanced practice route according to the development path of students' abilities.

Table 1. Geely college racing practice “three stage progressive” platform system architecture

Platform Level	Functional Orientation	Target Group	Core Task Matrix
Foundation Level	Cognitive Enlightenment & Interest Cultivation	Freshmen	Baja Racing Mechanical Principles Training, Basic Driving Training
Advanced Level	Specialized Skill Enhancement	Sophomores/Juniors	Formula Racing Car Design & Development, Racing Dynamics Simulation
Innovation Level	Cutting-edge Technology Research	Outstanding Undergraduates	Intelligent Driving Algorithm Development, Lightweight Material Applications

The foundation layer focuses on engineering cognitive enlightenment, cultivating new students' intuitive cognition and basic skills in automotive engineering through practical training in the principles of Baha racing mechanics and basic driving training. Deepen the enhancement of specialized technologies, relying on the design and development of Formula Racing and dynamic simulation projects, to exercise students' ability to solve complex engineering problems. The innovation layer aims to break through the forefront of technology, carry out research and development of intelligent driving algorithms and application of lightweight materials, and cultivate the original innovation ability of graduate students and excellent undergraduate students. The

three-level platform vertically connects and horizontally collaborates, forming a complete training chain of "cognition practice innovation".

3.2. Implement a two-way incentive mechanism of "credit exchange"

Build a two-way exchange system of "practical contribution academic output" and form a multidimensional incentive network based on "ability", including:

(1) Course replacement mechanism: Innovatively implement the "competency based" course exemption system. Core members of the racing technology team who have accumulated 2 years of practical experience and passed the technical committee's ability assessment can apply for exemption from three core theoretical courses: "Principles of Automotive Design," "Vehicle Dynamics," and "Engineering Materials Mechanics," and directly obtain corresponding credit certification.

(2) Credit recognition standards: Develop the "Detailed Rules for Credit Conversion in Innovation Practice" and establish a tiered incentive system, in which winning the first prize in national competitions can redeem 6 innovation and entrepreneurship credits, provincial and ministerial level awards can redeem 4 credits, and school level key projects can redeem 2 credits, forming a three-level incentive system of "national level-provincial and ministerial level-school level".

(3) Achievement Conversion Channel: Open the "Patent Replacement Paper" green channel, obtain invention patent authorization to apply for replacement of graduation design (paper), and establish a mechanism for distributing the benefits of scientific and technological achievement conversion. Student teams are allocated 10% to 30% of the conversion benefits based on their technical contribution, forming a closed-loop incentive system of "innovation conversion benefit".

3.3. Establish a closed-loop training system for "industry university research transformation"

Build a three-chain integrated education system of "industry chain docking, innovation chain cultivation, and transformation chain construction" to achieve the full chain connection of "basic research, technological innovation, and industrial application", including:

(1) Industry Chain Connection: Jointly build an event database with Geely Automobile Sports Department, incorporate CTCC China RV Championship and other event data into the teaching case library, synchronously import 28 technical standards from the development process of mass-produced vehicle models, and ensure the three-dimensional connection between practical training and industry needs through "technical specifications verification standards process specifications". Jointly establish a competition database with Geely Automobile Sports Department and Tianfu International Circuit, incorporating high-level event data such as CTCC China RV Championship and Tianfu International Circuit series into the teaching case library. Import technical standards from the development process of mass-produced vehicle models, draw on the advanced experience of Tianfu International Circuit in racing design, maintenance, operation, etc., to ensure the three-dimensional integration of practical training and industry needs through "technical specifications verification standards process specifications".

(2) Innovation Chain Cultivation: Establish 8 specialized innovation laboratories, including "Intelligent Driving", "New Energy Power", "Aerodynamics", and "Lightweight Materials", and implement a dual track system of "Enterprise Proposition + Independent Topic Selection". Among them, enterprise proposition accounts for 60% and focuses on forward-looking technology fields, ensuring the foresight and industrial relevance of innovation directions. Based on the facilities and resources of Tianfu International Circuit, establish specialized innovation laboratories such as "Intelligent Driving", "New Energy Power", "Aerodynamics", and "Lightweight Materials". Co organize technical seminars and innovation challenges with Tianfu International Circuit to attract enterprise proposals and promote the implementation of student innovation projects.

(3) Conversion chain construction: Establish a three-level conversion mechanism of "concept verification prototype development mass production conversion", and conduct feasibility analysis of industrialization through Geely Research Institute for excellent design solutions. Currently, three student innovation achievements have been promoted into the mass production vehicle development process. One of the aerodynamic optimization schemes is expected to reduce the drag coefficient by 0.03 and increase the range by about 8%. The application plan of a certain lightweight material reduces the weight of the vehicle body by 12% while maintaining collision safety performance, forming a value conversion loop of "teaching research industry". Establish a three-level transformation mechanism of "concept verification prototype development mass production conversion", cooperate with Tianfu International Circuit and Geely Research Institute, and conduct feasibility analysis on the industrialization of excellent design schemes. Utilize the testing site and facilities of Tianfu International Circuit to conduct prototype vehicle testing and validation. With the support of Tianfu International Circuit, student innovation achievements have entered the development process of mass production vehicle models.

4. Multidimensional analysis of practical effectiveness

Geely College's innovative teaching practice in motorsports has established a three-dimensional effectiveness system that covers the development of students' abilities, deepening of teaching reform, and expansion of social services, forming a three-dimensional educational efficiency pattern of "ability cultivation teaching reform social services".

4.1. Dimensions of student ability development

The innovative mode of practical teaching in motorsports at Geely College has achieved significant results in the development of students' abilities. These achievements are not only reflected in the improvement of students' engineering practice abilities, but also in the enrichment of innovative output results and the significant improvement of employment quality. The following will elaborate in detail from these three aspects:

(1) Engineering practical ability: Through the three-level training system of “theory simulation practice”, the efficiency of SolidWorks 3D modeling for racing team members has been improved by 40% compared to traditional training mode, and the design cycle of vehicle power matching has been shortened by 60%, demonstrating full process control ability from scheme planning to engineering implementation.

(2) Innovation output achievements: In the past five years, a total of 3 national level college student innovation and entrepreneurship training programs have been approved, 1 provincial gold award and 2 silver awards have been won in college student innovation competitions. Among them, the project of Safety and Passion-Helping China's Automobile Training completed its commercial transformation and won 135,000 yuan from the New Star Program of the Organization Department of Deyang Jingyang District Committee of the CPC. Applied for 6 national patents (including 3 invention patents), forming a complete innovation chain of “engineering practice creative incubation patent layout product transformation”.

(3) Improvement in employment quality: Graduates have an employment rate of 82% in core R&D departments of top automotive companies such as Geely Automobile Research Institute and BYD Central Research Institute. The average salary in the first year of employment is 31% higher than that of traditional engineering majors, and the proportion of promotion to supervisor level engineers within 3 years is 42%, indicating significant career development advantages.

4.2. Dimensions of deepening teaching reform

The practical teaching of motorsports at Geely College has not only achieved significant results in the development of students' abilities, but also promoted the reform and innovation of the entire teaching system. By restructuring the curriculum system, innovating the mentor mechanism, and reforming the evaluation system, Geely College has established a distinctive practical teaching system for motorsports. The following will elaborate on the specific practices of deepening teaching reform from these three aspects:

(1) Curriculum system reconstruction: Develop four characteristic courses, including Introduction to Racing Engineering, Racing Aerodynamics, Racing Electronic Control System Development, and Racing Lightweight Technology, and construct a modular course group covering “Basic Theory Special Technology Comprehensive Practice”. Among them, the ideological and political case of “Racing Aerodynamics” course has been selected as an excellent provincial demonstration case.

(2) Innovation of mentor mechanism: Establish a tripartite guidance system of “enterprise technical experts + academic mentors + competition coaches”. Enterprise mentors participate in practical teaching for more than 80 hours per year, academic mentors track scientific research training throughout the process, and competition coaches provide specialized guidance for competition preparation, forming a three-dimensional education mechanism of “industry academia competition”.

(3) Reform of evaluation system: Construct a multidimensional evaluation system of “process assessment (40%) + outcome assessment (60%)”, in which process assessment includes 5 stage evaluations, outcome assessment introduces enterprise technical standards as the core indicator, and the weight of enterprise mentor evaluation reaches 40%, forming a “dynamic monitoring terminal evaluation” dual loop quality assurance.

4.3. Dimensions of social service expansion

In addition to deepening teaching reform, Geely College's practical teaching of motorsports also actively expands its social service functions. Through various means such as technical support, science popularization radiation, and industry exchange, Geely College has provided a platform for technical support, science popularization education, and industry exchange for society, further enhancing the influence and social value of practical teaching. The following will introduce specific practices for expanding social services from these three aspects:

(1) Technical support: Established a racing technology sharing alliance with 5 higher education institutions in the Chengdu Chongqing region, signed cross school course mutual recognition agreements, developed 8 shared course modules, covering core courses such as racing mechanics principles, and formed a regional vocational education development community.

(2) Science Popularization Radiation: Continuously carry out the “Racing Science Popularization into Campus” public welfare activity, and have visited 12 middle schools. Through VR racing simulation experience, aerodynamic experiment demonstration, driver career sharing and other forms, more than 2,000 middle school students have been benefited, effectively stimulating the interest of young people in engineering innovation, and obtaining provincial science popularization education project approval support.

(3) Industry Exchange: Organize and host 3 technical forums in the field of automotive engineering, invite industry experts to give 15 lectures at the school, establish a platform for school enterprise cooperation and exchange, and promote the deep integration of industry, academia, and research development.

5. Existing challenges and optimization strategies

5.1. Typical challenge analysis

While achieving significant results, Geely College's practical teaching of motorsports also faces some challenges. These challenges mainly focus on the conflict between the competition cycle and teaching pace, insufficient interdisciplinary collaboration, and increased pressure on safety control. In order to address these challenges, Geely College has proposed corresponding optimization strategies aimed at further improving the quality and level of practical teaching. The following will elaborate on typical challenges and response strategies from these three aspects.

(1) Conflict between competition cycle and teaching pace: In response to the mismatch between competition preparation and teaching cycle, an innovative "segmented" task management matrix is constructed to scientifically decompose the entire process of racing research and development into 12 modular teaching units. A dynamic mapping mechanism between season cycle and teaching calendar is established to achieve precise matching and collaborative promotion between research and development process and teaching activities.

(2) Lack of interdisciplinary collaboration: In response to the demand for interdisciplinary integration, a "Automotive + Electronics + Management" interdisciplinary joint teaching and research group has been established to break through traditional disciplinary barriers, develop cross disciplinary curriculum systems such as "Racing Marketing Management" and "Racing Cost Control", construct a "Technology Business" dual helix talent training model, and promote the cultivation of students' composite abilities.

(3) Increased pressure on safety control: In response to the safety risks in the development and testing of racing cars, a dual safety prevention and control system of "virtual simulation + real vehicle testing" has been created. An intelligent driving training system has been introduced to build a "human vehicle field" closed-loop testing environment, effectively reducing the risk coefficient of testing through the combination of virtual and real, and improving the level of safety protection.

5.2. Future development direction

While facing challenges, Geely College has also actively planned the future development direction of practical teaching in motorsports. Based on the existing practical foundation, the college will focus on promoting intelligent upgrading, international expansion, and ecological construction to adapt to the development trend of the automotive industry and enhance the competitiveness and influence of practical teaching. The following will specifically elaborate on the future development blueprint of Geely College's racing sports practical teaching from these three directions:

(1) Intelligent upgrade path: In response to the trend of intelligent development in automobiles, we will develop an autonomous driving racing teaching platform, integrate V2X vehicle road collaborative communication technology teaching modules, create a new highland for talent cultivation in intelligent connected vehicles, and seize the future technological high ground.

(2) Internationalization Expansion Layout: Deepen international cooperation and exchanges, jointly establish the "China Europe Racing Technology Innovation Center" with Paderborn University in Germany, develop bilingual course modules, build an international joint training system, and enhance the internationalization level of education.

(3) Ecological construction vision: Focusing on the deep development of industry education integration, planning the "Racing Town" industry education integration demonstration zone, building a "research and development manufacturing experience" full industry chain ecology, forming an innovative ecosystem of deep integration of industry, academia, research and application, and creating a new paradigm of industry education integration.

6. Conclusion

Geely College has innovated through practical teaching in motorsports and deeply integrated resources from the Tianfu International Circuit, constructing a new mode of education that deeply integrates the four chains of "education chain talent chain industry chain innovation chain". This model not only significantly improves students' engineering practice ability and innovation and entrepreneurship literacy, but also provides high-quality talent support for the transformation and upgrading of the automotive industry. In the future, Geely College will continue to deepen cooperation with Tianfu International Track, jointly explore more innovative practical teaching models, and contribute to the cultivation of engineering innovation talents with international competitiveness. Subsequent research can focus on exploring the application scenarios of 5G + digital twin technology in practical teaching of racing, as well as the docking mechanism between the racing sports certification system and international engineering education certification, in order to continuously deepen the "integration of racing and education" educational paradigm.

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