ISSN 2663-8169 Vol. 5, Issue 22: 147-152, DOI: 10.25236/IJNDE.2023.052225

Research on Teaching Reform of the Course "Vehicle Network and Information System Maintenance" Based on CAN FLEXRAY Bus Networking Technology

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Abstract: *The course 'Vehicle Network and Information System Maintenance' is a core professional course in the field of new energy vehicle technology and automotive electronics technology, and is also an important technology in the automotive industry. Especially with the rapid development of new energy vehicle technology, the transmission of automotive information within the vehicle and the proportion of in vehicle network technology in automotive technology are becoming increasingly high. With the continuous emergence of new car network technologies, the traditional teaching of "Car Network and Information System Maintenance" mainly introduces the theory of car networks, and through theoretical explanations, students can understand car networks. Universities with good teaching conditions will have some experiments, but the experiments are all based on simple operations. Students can only use simple buttons, handles, etc. to simulate operations or use decoders to read messages. However, there is little involvement in how messages are packaged and transmitted in numerous car controllers. In order to cope with the rapid development of car network technology, it is urgent to solve these problems. This requires reform of the course "Car Network and Information System Maintenance", designing courses and practical training that are in line with the development of car network technology to make up for the shortcomings of traditional teaching.*

Keywords: *CAN-FlexRay bus; Course Reform; Practical Training Reform*

1. Introduction

The course "Vehicle Network and Information System Maintenance" is generally set in the second semester of sophomore year. Before studying this course, students have already studied basic courses in electronics and practical courses, microcontroller principles and projects, which has laid a solid foundation for the reform of this course. Because the reform of this course will shift from focusing on explaining theory to integrating theory with practical training design, explaining a portion of the theory will lead to the design of corresponding practical experiments to verify the theory learned. The designed practical experiments are all based on the actual work content of automotive design enterprises, truly enabling students to learn technologies that can be applied in practice. The practical training students learn is the skills that can be used in real work, and students will complete this course. It's equivalent to interning in a company for a semester, in order to truly achieve the unity of teaching and work, and avoid students completing corresponding courses, only knowing some basic theories and concepts of this course. After arriving at the company, they still have little knowledge of relevant technologies, let alone directly participating in actual projects of the company.After introducing the actual project design of the enterprise, students can jump out of the pure theory, go from theory to practice, and then from the problems that arise in practice to the closed-loop of consolidating theory. Through this closed-loop learning, students can truly master the theory and design skills of car networks. The reform of this course is divided into three aspects: curriculum, practical training, and ideological and political education. The overall plan is shown in Figure 1.

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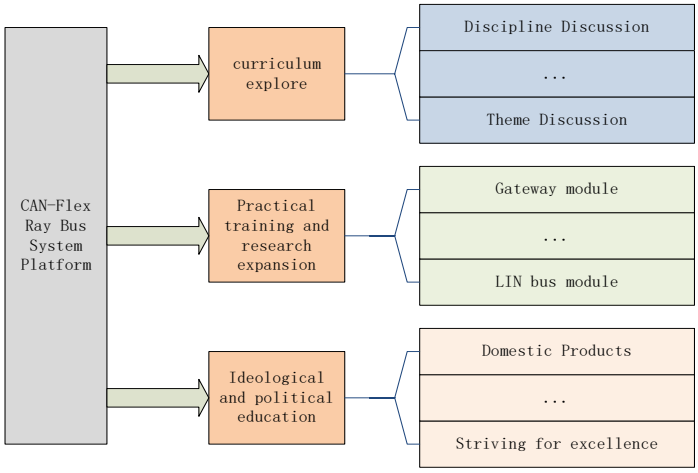

Figure 1: Overall Plan for Curriculum Reform

2. Course Reform of "Vehicle Network and Information System Maintenance"

This course reform is mainly based on the CAN-FLEXRAY bus networking technology project, designing relevant exploration courses and practical experimental courses. The reform of exploring curriculum design is mainly reflected in the transition from teachers to students participating in the exploration and design, and the introduction of corporate mentors for explanation. The exploration and design courses are divided into four categories, namely, in vehicle network cognition courses, in vehicle network research and exploration courses, in new energy vehicle professional research and development courses, and in vehicle network project research and innovation courses. The design scheme is shown in Figure 2.

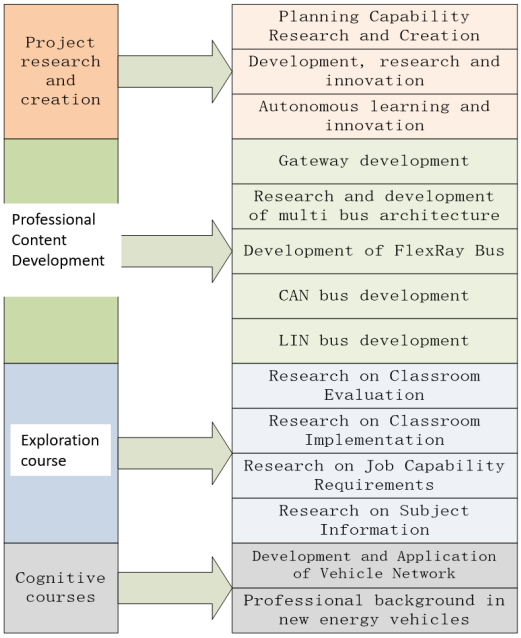

Figure 2: Curriculum Reform Design Plan

The cognitive course mainly focuses on understanding the skills required by enterprises based on teaching theories. Taking CAN bus as an example, the theory designed in the textbook only explains the concept of CAN bus, the architecture of CAN bus, and the components of CAN bus messages[5]. After this curriculum reform, a CAN bus cognition course was established. Taking one of the courses as an example, it was introduced through a physical work video of the CAN bus. [2]By operating the input device, students were able to see the rotation of the executing motor, which guided them to think about why the motor rotates and how the command for motor rotation was given. After the group discussion, the teacher analyzed and explained the advantages and disadvantages of each group's plan

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based on the ones provided by each group. Finally, they came up with the most reasonable plan that everyone believed was reasonable. They compared it with the standard plan in the textbook to see if there were any areas that could be improved. If there were any, they went back to see what was missing in their design and compared it with their original design. Through this process, Not only can students firmly grasp the knowledge points, but it also effectively exercises their ability to analyze and solve problems. Through this process, students will have a thorough understanding of this knowledge and solve the problem of abstract theoretical knowledge of vehicle networks.

The design of the research and exploration course focuses on exploring the course of vehicle network and information system maintenance. The exploration content includes the knowledge and skills points of this course, and the knowledge and skills points that should be mastered in the courses related to this course. The related courses include pre courses and subsequent courses. Taking the pre course as an example, the pre course of car network includes fundamentals of electronics, automotive electronics, microcontroller applications, etc. If it is necessary to design a car's car network hardware system, what knowledge and skills points do students think will be used in the relevant courses they have learned before? For example, when designing vehicle network hardware systems, circuit knowledge in electronics and network controller knowledge in automotive electronics are needed. It is necessary to use the communication skills of the microcontroller application course to horizontally connect the knowledge points in each vertical knowledge chain, so that students can form a two-dimensional knowledge surface with a single knowledge chain. Through this training, not only can students have a clearer understanding of the knowledge of the subject, but also their integrated understanding of the subject can be enhanced to a new dimension[3].

The main purpose of the professional research and development course is to discuss the new major of new energy vehicles. The content discussed here needs to be limited, as the industry chain and technology enterprise scope involved in the new energy vehicle profession are too broad. This mainly discusses the position and role of in vehicle communication in the new energy vehicle industry, as well as emerging network technologies. Taking the emerging FlexRay network as an example, where are the advantages of the FlexRay network and why it emerged? The most important feature of the FlexRay network is its fast speed, safety, and low cost. These characteristics are urgently needed for the rapidly developing new energy vehicle industry, as the new energy vehicle industry is a new track where everyone is on the same track and is in the stage of researching and practicing new technologies.The information transmission volume of the new smart car has increased significantly, and if the network speed is slow, it cannot achieve the effect of timely transmission. On the basis of the CAN network, the FlexRay network has increased its speed by 20 times and can quickly transmit information.With the continuous increase of new energy vehicles in the market, the safety of new energy vehicles is a matter of great concern, especially the occasional occurrence of safety accidents in autonomous driving, which has undermined consumer confidence and had a negative impact on the development of the new energy vehicle industry. [1]This requires that the design of new energy vehicles particularly needs to improve safety design, especially for in vehicle networks, Although the redundancy design of the FlexRay network sacrifices a certain amount of speed, information security always needs to be put first. Through the redundancy design of the FlexRay network, network security issues have been well solved, which is the reason for the rapid development of the FlexRay network.

The project research and innovation course mainly introduces the actual project of the supervisor and conducts design discussions based on the actual project. Used to inspire students' innovative thinking and practical scientific research abilities, this dimension of class requires students with spare energy to lead discussions and group according to their learning situation. This group cannot be freely combined, and it needs to be adjusted by the teacher on the basis of free combination to allow students at different levels to have thinking collisions, in order to achieve good results. Here, we will take the CAN-FlexRay bus networking project as an example to explore. The CAN-FlexRay bus networking project is designed based on the actual needs of the enterprise, and all hardware designs need to pass the standard inspection of the automotive industry. The software has also undergone strict inspection of the actual project process through research and demand, team development, small batch trial production, and actual vehicle feedback. Here, students are asked to discuss how to design such a product based on the needs of the enterprise, the steps involved in the design process, and the issues that need to be paid attention to during the design process. Through this discussion, students not only master the actual development process of the CAN-FlexRay bus networking project, but also have a deeper understanding of the designed R&D project. Through such training, students can truly move from the classroom to their positions, from theory to practice, and from following to innovation.

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3. Practical Training Reform of the Course "Vehicle Network and Information System Maintenance"

The curriculum reform of "Vehicle Network and Information System Maintenance" not only includes curriculum reform, but also focuses on practical training. Traditional vehicle network training is basically simple operation, and those with good conditions can use a decoder to read fault codes. Such training is obviously no longer suitable for the rapidly developing new energy vehicle industry. This teaching reform has designed three levels of training, namely basic level training, Improve the level of practical training and system innovation practical training. The design scheme is shown in Figure 3.

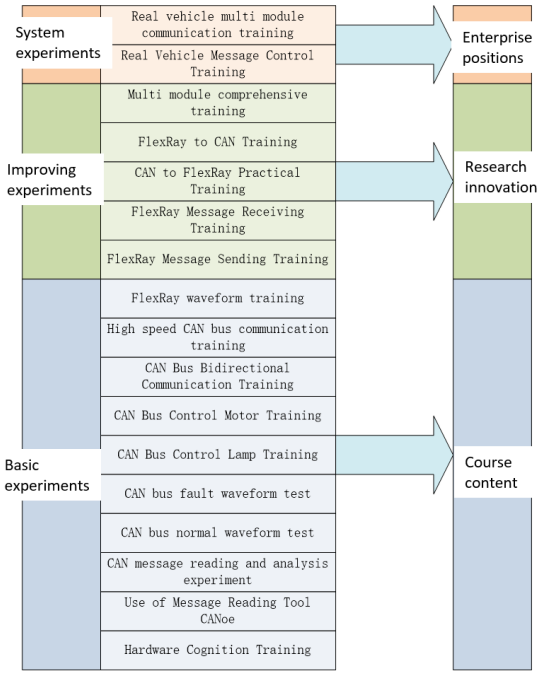

Figure 3: Multilevel Practical Training Design Scheme

The basic level training mainly includes the basic experiments and course selection experiments of the car network course, including basic CAN hardware cognition training, practical training on the use of car network tool canoe, practical training on reading and analyzing CAN messages, practical training on CAN communication waveforms, practical training on analyzing CAN fault waveforms, practical training on CAN bus control lamp coding, practical training on CAN bus control motor coding, practical training on CAN bus dual wire communication, and practical training on high-speed CAN bus communication, FlexRay hardware cognition training, FlexRay bus waveform training, FlexRay fault waveform training, etc.Basic practical training is mainly used to consolidate the foundation of vehicle network, proficiently master basic hardware systems, basic vehicle network tools, and basic bus waveforms. Choosing to do practical training includes reading and analyzing complex fault waveforms, actual code writing and debugging, etc. The form of selection is not to do it alone, but to group it in groups of three people, doing three experiments, with each student completing at least one or all three, Score based on the amount completed, in order to form cooperation and competition within the group, stimulate students' competitiveness in learning, and create a good atmosphere of mutual assistance and competition.

The practical training for improving the level mainly involves designing comprehensive experiments for the course, which is designed based on the internship position of the vehicle network and combined with the course. It includes practical training on sending and receiving FlexRay bus messages, converting CAN messages to FlexRay bus messages, converting FlexRay bus messages to CAN bus messages, and comprehensive communication training on FlexRay bus network and CAN bus network.It can be seen that the difficulty of improving the level of practical training is significantly higher than that of basic level practical training, and the designed practical training mainly comes from actual vehicle network work positions and emerging vehicle network technologies. This part of practical training focuses more on cultivating students' practical abilities and is not satisfied with the training of basic knowledge. After improving the level of practical training, students can basically be

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competent for the internship position. Compared with students who have not received such training, they will have a huge advantage in the work position, which can give students a bright feeling as soon as they enter the company and lay the foundation for their career.

On the one hand, the innovative practical training of the system comes from practical training conducted on real vehicles, including hardware cognition, message reading, waveform testing, fault code reading, and data reading; On the one hand, it comes from practical scientific research projects, such as the development of network platforms, the development of FlexRay bus gateways, and the development of CAN-FlexRay bus data masters[4];You can also design semi physical simulations of modules and real vehicles, allowing your designed modules to receive messages from real vehicles, control the output of your module's actuators, truly bridge the barriers between training and positions, the gap between teaching and research, and achieve the integration of teaching and research, integrating scientific research into teaching and training, and achieving scientific research in teaching and training. At the same time, students' innovation and entrepreneurship competition projects can also be introduced to further stimulate their interest in learning. Through learning a course, not only can they firmly grasp the knowledge and skills of the subject, but they can also participate in college student competitions and win awards, which is of great help to their job positions after graduation.

4. Ideological and political reform

The reform of university courses not only includes the reform of teaching content, but also ideological and political education. Traditional classrooms only teach students knowledge and skills, while modern education requires not only improving students' skills but also enhancing their various qualities, and engineering courses are also the same. As a core professional course in the new energy vehicle industry, the onboard network course is no exception. This course reform has introduced ideological and political design in both course design and practical training design.For example, during the training process, the training tools we used, such as oscilloscopes, decoders, and multimeters, were all domestic brands, and the actual vehicles we used were also leaders in the domestic new energy vehicle industry - BYD. In the discussion class, guide students to discuss why China needs to develop new energy vehicles, the status of China's new energy vehicle industry in the international community, etc., and inspire students' patriotism and pride in national enterprises. In the process of conducting experiments, special attention should be paid to details, and the transmission of information must be accurate without any errors. Even a single bit of data error may cause safety accidents, conveying the spirit of excellence to students. For the achievements we have already made that cannot be satisfied, we should recognize our shortcomings and establish the idea of endless research. The design scheme is shown in Figure 4.

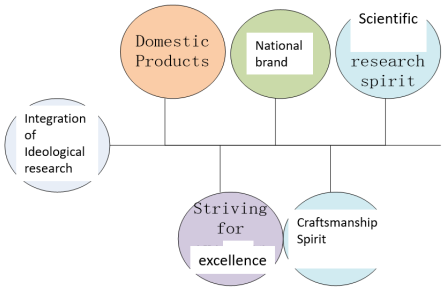

Figure 4: Ideological and Political Design

5. Conclusion

Through the teaching reform of the course of vehicle network and information system maintenance, the teaching content of the vehicle network course has been made clearer and closer to the actual situation of the position. On the basis of traditional classrooms, cognitive courses, research and exploration courses, professional research and development courses, and project research and creation courses have been set up, allowing students to become the masters of the teaching classroom, truly integrating into the classroom, stimulating students' learning enthusiasm, and introducing ideological and political education to enable students to learn in the process, Simultaneously improving one's thinking.[6]The design of practical training is divided into basic training, improvement training, and

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system innovation training according to the actual situation, to meet the needs of students at different levels. Through the reform, the teaching effect of the course "Vehicle Network and Information System Maintenance" has been significantly improved, achieving good teaching results.

Acknowledgement

This paper corresponds to the 2022 Wenzhou Polytechnic Research and development of a comprehensive research project on feedback teaching: Exploration and Research on Backfeeding the Course Teaching of "Vehicle Network and Information System Maintenance" base CAN-FlexRay Bus Networking System R&D Project (WZYYFFP2022008).

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