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Discussion of the Train Control System Course Teaching

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Abstract :*Since China railway has increased the train speed after the 6th time, the automatic train control system has achieved wide application. Train control system is a signal system to ensure the train safety, and its importance is more and more highlighted with the development of the railway. Our school opened this course for the students in the major of rail transit signal and control, and now it has become one of the core courses for the major of rail transit signal and control. This work will discuss how to combine the theory and practice in the course teaching and how to improve the teaching quality.*
Keywords -*Train control system; Course teaching; Teaching Quality*

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I. INTRODUCTION

Train control system is one of the key and core courses in the major of rail transit signal and control. It mainly teaches the following content [1-3]: basic knowledge of the train control system, basic work principle, ground-train information transmission technology, speed measure and positioning technology, CTCS-2 train control system, CTCS-3 train control system, functions and features of the coding of continuous track circuit, basic principle of the equipment and the analysis methods of the faults, etc. Teaching method adopts the project-oriented, task-driven teaching mode, and efficiently use the digital teaching manner, student centered, and highlight the cultivation of the professional ability.

In order to enable the students to better grasp the use of the equipment and related maintenance skills of the train control system, further satisfy the requirements of the enterprises, and enhance the competitiveness of graduates, we adopt "demand orientation, goal orientation, task oriented" principle to build the overall course design, and execute the project teaching research.

After many years of the teaching exploration, we have accumulated much experience on how to combine the theory and practice in the course teaching to enhance the teaching quality effectively. Next, we will analyze and discuss how to realize these goals.

II. MANNERS TO IMPROVE THE TEACHING QUALITY

(1) Develop the teaching goal

Train control system is an important part of railway transportation management system, and it mainly uses many effective technical means to realize the real-time monitoring and over-speed protection for the train operation interval and speed, make the train running safety and improve the operation efficiency, and lighten the working strength of drivers, improve working conditions and passengers' comfort. Mission and goal of the course of the train control system is to enable the students to master the basic knowledge and basic skills of the modern signal system, improve the skill level of the signal staffs, and serve the railway effectively. To achieve good education and teaching quality, the teacher should understand the training objective of the major and the course, and the curriculum standard of this course, thus to develop the corresponding teaching plan accordingly.

Concretely, the knowledge target requires the students to grasp the basic knowledge of the train control system, basic work principle, ground-train information transmission technology, speed measuring and positioning technology, CTCS2/3 train control system, corresponding knowledge of the coding. Ability goals include that through learning of this course, students can online measure the parameters of the equipment, read related circuit diagram, and adjust the track circuit. In addition, they can analyze and address the faults in the equipment of the CTCS-2/3. Quality goal, through learning of this course, the student's responsibility consciousness, safety consciousness and team cooperation spirit should be cultivated. Through completing the three goals, the students should be cultivated with the professional ability to maintain the equipment of the railway train operation automatic control system.

(2) Reasonable selecting the teaching content

Feature of the course of the train control system is strong application. The train control system is made up of ground equipment and on-board equipment. Ground equipment is mainly composed of some signal equipment, its function is to check the train location and occupancy in the interval, forming speed signal, delivering the allowed train speed, and control information, such as the circuit parameters, to the train. On-board equipment is mainly composed of antenna, signal receiving unit, the brake control unit, the driver console monitor, speed sensor and so on. Its function is calculating the train speed control curve, real-time supervising the train running status, controlling the train to run safely and speedy, based on the ground of the received information, combined with the characteristics of the train.

The Chinese train control system is divided into 5 levels: CTCS-0 to CTCS-4. After the 6th speed increasing, the train has adopted the CTCS-2 train control system. After many years development, the CTCS-2 level has generated a relatively mature technology system [4], and the running speed is 200~250 km/h. The CTCS-3 train control system adopts the GSM-R to transmit the control information as the ground-train transmission media [5]. Running speed can reach 300~350km/h. While CTCS-4 is the development direction in the future, and it has not been applied in the practice nowadays. So we should combine the actual railway site and developmental trend to wisely choose the teaching content, not trying, but must grasp the point.

(3) Adopting efficient teaching manners

Since the content of the train control system are basically about the functions, construction and working principle of the on-board equipment and the ground equipment, and the teaching content is very boring. So the excellent and efficient teaching methods will produce great effect. Effective teaching methods can not only broaden the student's marketability, increase teaching information, but also improve the students' interest in learning. At the same time, in interpreting the CTCS-2 and CTCS-3 train control system, the teacher can use the self-developed train control simulation platform; After studying the locomotive signal and LKJ monitoring devices, the teacher can take the students to the scene and carry out the scene teaching, visit the locomotives, both realize integrating theory with practice, and achieve the conversion from abstract to concrete, so that the students enthusiasm is greatly improved, so as to improve the teaching quality.

Meanwhile, the teacher can use the project-oriented, task-driven teaching mode. Next we take the fault analysis of the ground equipment of the CTCS-2 train control system, namely, the ZPW2000A insulation track circuit, as an example to discuss the implementation process of the course teaching mode. First step is the task assignment, and clear the task content, procedures and the standards of every group, then the students discuss the corresponding tasks, based on the fault phenomenon, the students are asked to analyze carefully, and write down the judgment and analysis process. Then, students are asked to discuss the results and repeat the testing and verification to find out the fault point. Finally, the teacher checks the complete task and gives the evaluation. In guiding students to complete the tasks, this teaching mode can cultivate the students' ability to analyze and address the ZPW2000A insulation track circuit fault. This course teaching mode also embodies the student-centered vocational education idea, highlight the characteristics of the vocational ability training.

Moreover, combined with a variety of teaching methods, including the multimedia teaching, the teacher can use the animation to demonstrate the complicated circuit principle, such as indoor equipment transmitter N+1 redundancy system schematic diagram of the ZPW2000A insulation track circuit, and animation will be used to explain the action procedure of the track circuit. The teacher can also adopt the scene teaching, explain the composition and the principle of the equipment in facing the physical entity. This teaching mode can make knowledge more stereo and intuitive, stimulate the students' interest in learning, so as to achieve good teaching effect.

(4) Reasonably use the teaching resource

The teacher can reasonably use the teaching resources, such as using a variety of video to introduce the railroad new knowledge and new technology to the students, develop the students' field of vision. Using the multimedia courseware to replace the traditional blackboard writing can make the circuit diagram more normative, and knowledge more rigorous. Using the network teaching resources, in order to mobilize the learning enthusiasm and initiative of the students, the teaching team actively build a network course, i.e., equipment maintenance of the automatic train operation control system, which provides a good network interactive platform, the students can surf the Internet access to information, realizing the autonomous learning. This also reflects the design concept of the course open. We also provide several network resources, thus the students can understand the latest professional information of railway communication signal.

Moreover, we build strong relation with the relative enterprises in the rail transit field, such as Institute of Henan Siwei, Lanxin Technology of Zhengzhou, SALEM Traffic, Yuling Technology，etc，the students can go to the enterprises to practice and operate the real rail transit systems.

(5) Efficiently use the curriculum design

Through the curriculum design, the students can deepen the understanding the knowledge they have learned. So the teacher can encourage the students to make a simple train control system. After introducing the composition and working principle of the CTCS-2 train control system, and the working principle of wireless transmission module of the CTCS-3 train control system, the teacher can assign the students a curriculum design content, i.e., through imitating the control principle of the CTCS-2 train control system, the students are asked to design a simple CTCS-3 train control system. Because partial modules in the CTCS-3 train control system are the same as those in the CTCS-2 train control system, as long as the students master the working principle of the GSM-R wireless transmission module and the Radio Block Center (RBC), it is possible for the students to design an overall architecture of a simple CTCS-3 train control system. Through such course design, students are forced to search information, realizing the independent learning and independent design, then the teacher gives some guidance and help. The effect of this curriculum design must be stronger than the teacher's abstract talking in the class.

Furthermore, the teacher can assign more similar curriculum designs to the students and ask them to independently carry out these tasks, such as the design of the wireless signal transmission of the RBC, ground-train information transmission mode of the ZPW2000A insulation track circuits, working modules transform of the CTCS-2 train control system, realization of the automatic block of the CTCS-3 train control system, etc. All these designs can effectively improve the creative and autonomous ability of the students.

(6) Establishing the standards of fault analysis and processing procedure

We should establish the standards of the malfunction analysis and processing procedure, and analyze and discuss the real site of railway case, cultivate the students' responsibility consciousness and safety consciousness, make them having a clear understanding of the professional orientation in the future.

Finally, we should successively improve the training conditions. With the development of the science and technology, the equipment in the rail industry are constantly updated, as the vocational education school train the professional technical personnel for the enterprises, actively improving the training conditions must be put in the first place.

If we can effectively perform the above six aspects about the teaching of the train control system, at the same time, we should pay attention to adopting various attitudes towards different students, try every mean to inspire the students' learning passion, cultivate their creative idea.

III. CONCLUSION

The above mentioned are the discussion of the train control system of the major of rail transit signal and control. It is noteworthy that different schools have different cultivation goals, and there is no unified teaching modes. Considering the technology in the rail transit field develops very fast, the teachers are also required to successively improve their professional ability and professional quality. With this in mind, we should explore more effective teaching manners to successively enhance our teaching quality.

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