

Construction of Rail Transit Signal and Control Virtual Teaching and Research Center

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Abstract: In view of the contradiction between the large demand for rail transit signal and control talents and the lack of professional teachers as well as the urgent need to improve the training quality of professional talents, the construction of rail transit signal and control virtual teaching and research center is carried out through interschool and school-enterprise joint ventures, so as to meet the needs of professional talent training. Taking the rail transit signal and control specialty of Lanzhou Jiaotong University as an example, this paper discusses the construction connotation, content, and characteristics of virtual teaching and research center to provide reference for the construction of professional virtual teaching and research center.

Keywords: Virtual teaching and research center; Rail transit signal and control; Curriculum innovation; Combination of virtual and reality

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1. Introduction

The Rail Transit Signal and Control major cultivates professionals in the rail transit industry, who are able to master the railway signal control technology and train control technology. With the implementation of the national strategy of “railway first for a powerful transportation country,” “eight vertical and eight horizontal” railroad network planning, and the vigorously developing urban rail transit strategy, there is a huge shortage of professionals. Therefore, since 2012, the major has been listed in the national catalogue of undergraduate majors of ordinary colleges and universities, and as many as 90 colleges and universities in China are offering the major. At the same time, the lack of teachers and training resources in various experimental schools is plagued by the lack of professional teaching resources. Solving the contradiction between the high demand of the society for these talents and the relative lack of professional teachers as well as the urgent need to improve the training quality of professional talents has become an urgent problem for the current Rail Transit Signal and Control specialty ^[1].

Virtual teaching and research center can improve teachers’ understanding of textbook knowledge and industry development as well as shorten the “weaning period” of new teachers. By carrying out trainings for teachers and promoting teaching and research exchanges among colleges and universities at different levels, the teaching objectives can be clarified, so as to carry out teaching activities suitable for students in each school. In terms of the cultivation of students’ practical skills, the co-construction and sharing of high-quality resources as well as the improvement of students’ ability to combine theory and practice are easier to implement through the co-construction of laboratories by schools and enterprises, the sharing of teachers in enterprises, as well as the training and exchange of new technologies.

Therefore, the construction of rail transit signal and control virtual teaching and research center should be carried out through interschool and school-enterprise joint ventures, so as to meet the needs of professional talent training, with practical and feasible methods.

2. Brief introduction of the Rail Transit Signal and Control major of Lanzhou Jiaotong University

The Rail Transit Signal and Control (formerly known as Railway Signal) specialty is a special course (080802t) under the automation category (0808). In order to ensure the safety of running and shunting operations, improve the carrying capacity of stations and sections and the ability of train disassembly, as well as improve the working conditions of operators, it is necessary to cultivate specialized talents in information and control in the fields of high-speed railway, ordinary-speed railway, subway, and urban rail transit.

The Rail Transit Signal and Control (formerly known as Railway Signal) major of Lanzhou Jiaotong University was established at the beginning of its establishment in 1958. It is the only undergraduate major with distinctive and profound characteristics of rail transit that has continuously recruited students since 1958. It was renamed as Automation (Automatic Control) in 2003 and was approved as a national characteristic major in 2009. In 2012, it was renamed as Rail Transit Signal and Control according to the professional directory of the Ministry of Education. In 2013, it introduced the Mao Yisheng Class and was approved as a national first-class undergraduate professional construction site in 2019.

Graduates with Rail Transit Signal and Control major have become leaders and key technicians in major railway bureaus, subway companies, design institutes, construction units, general contractors, and equipment manufacturers in China. Since the past few years, 280 undergraduates are being trained every year, and the employment rate is stabilized at more than 97%, which has transported a batch of professional and technical talents for the implementation of the national strategy. The employment rate of master's and doctoral students is 100%, which is the main source of teachers for newly established colleges and universities offering the Rail Transit Signal and Control major since 2012.

3. Construction connotation and characteristics of virtual teaching and research center

Virtual teaching and research center is the main form of grass-roots teaching organization, which is the cornerstone of promoting the connotative development of higher education in China. It is a teaching and research team composed of interdisciplinary, inter-university, and even inter-national teaching and research workers. In order to solve the problems in higher education and teaching, it uses network information technology ^[2]. The connotations of rail transit signal and control virtual teaching and research center are discussed below.

(1) Virtual teaching and research center is a special teaching and academic community.

The virtual teaching and research center of rail transit signal and control specialty aims to serve the education and teaching practice in the field of railway signal and urban rail transit signal, deliver a support mechanism for communication, research, and improvement of teachers' teaching ability, as well as provide a training demonstration platform for practicing advanced teaching concepts and promoting advanced teaching techniques and methods, in order to realize artistic, humanized, and scientific knowledge transmission of rail transit signal and control ^[3].

(2) Virtual teaching and research center is the innovative growth of traditional teaching and research center. As the virtual teaching and research center has the characteristics of dynamic flexibility of membership, combination of virtual and real members, as well as the dynamic flexibility of organizational structure, the teaching and research activities of online meetings have become the norm; the way of teaching and research is also different from the traditional teaching and research center, which assumes authority as the core. It embodies flat management, democratic discussion, equal co-construction, and sharing.

Combined with the professional characteristics, the characteristics of rail transit signal and control virtual teaching and research center are discussed below.

- (1) It is necessary to encourage enterprise participation and revitalize teaching resources; set up a virtual teaching and research center, fully implement the main idea of mutual assistance in teaching, transform closed teaching activities into “online + offline” open teaching activities by breaking the barriers between schools and enterprises, expand the experience of well-known teachers into group wisdom^[4], as well as establish an “intelligent +” teaching and research platform based on the internet. Trainings should be actively carried out, and training courses should be held regularly. Inviting well-known teachers, first-class course leaders, and field engineers with rich practical experience to conduct centralized training will improve the teaching skills of front-line teachers.
- (2) Teaching and research should echo well-known teachers to improve the level of teachers. It is important to give full play to the leading role of well-known teachers, carry out the construction and practical activities of network-based virtual teaching team, virtual course group, as well as virtual teaching and research center, and promote the scattered highlights of teaching and research into a wider range of achievements through inter-school exchanges, so as to improve the teaching and scientific research level of the specialty in colleges and universities across the country as a whole.
- (3) It is imperative to improve teaching resources, co-construction and sharing, as well as school-running conditions. In terms of professional talent training plan, subject system construction, professional core curriculum outline, and teaching plan, multiple schools should come together to jointly build and share. Based on platforms such as “National Virtual Simulation Experiment Teaching Center for Rail Transit Information and Control” and “National Experimental Teaching Demonstration Center for Comprehensive Innovation of Information and Control Engineering” in Lanzhou Jiaotong University as well as the concept of virtual reality combination with online and offline shared services, research on the co-construction and sharing of professional virtual simulation experiment teaching resources should be carried out and professional experimental conditions should be improved; virtual simulation technology can be borrowed to establish an interdisciplinary practice and innovation platform^[5].

4. Construction contents of virtual teaching and research center

The virtual teaching and research center of rail transit signal and control specialty is a novel and effective measure to alleviate the shortage of teachers in this specialty. It breaks through the space-time constraints between schools and enterprises and innovates the “college-department course group” and “college teaching team” construction methods. In the construction of virtual teaching and research center, exploration and practice can be carried out in two aspects: virtual curriculum group and virtual curriculum teaching team. The main construction contents are discussed below.

- (1) Considering the actual situation and geographical location, the exploration of the construction of “point-to-point” virtual teaching and research center can be carried out in the initial stage. Schools should determine the course through negotiation (primary selection of basic rail transit signal or station interlocking technology) to carry out interactive teachings for certain chapters^[6], so as to achieve the purpose of sharing the resources of well-known teachers and strengthen offline communication. This will in turn improve the diversification of the teaching contents in each school.
- (2) After the initial stage, it is then possible to carry out the construction of “point-to-multipoint” virtual course group. In this stage, it is important to summarize the experience of the initial course teaching, improve the implementation strategy, and mobilize more teachers from similar courses in the virtual teaching and research center to participate in the network synchronous teaching of multiple courses in the virtual course group. By having the teaching staffs to jointly create and share teaching videos and teaching cases as well as to carry out after-school “online + offline” discussions, their teaching methods

and the teaching evaluation will improve.

- (3) In the later stage, the operation mechanism of “multipoint-to-multipoint” virtual teaching and research center should be improved. By strengthening cooperation, the number of cooperative colleges and universities should be expanded, and the experience in the construction of virtual curriculum teaching team and virtual curriculum group should be used for the effective cooperation among the virtual teaching and research centers of multiple schools. At the same time, it is important to actively expand school-enterprise cooperation, include excellent engineering and technical personnel from enterprises to the virtual teaching and research center teaching team, as well as incorporate new technology training, engineering practice exchange, and scientific research project cooperation, so as to improve the engineering practice experience of front-line teachers, consolidate the theoretical foundation of those enterprise engineering and technical personnel, as well as effectively improve students’ skills in solving professional complex engineering problems.

The construction of virtual classroom is carried out around the core task of constructing teaching teams and teaching resources through three levels: teaching discussion, teaching implementation, and teaching research cooperation^[7]. Among them, teaching discussion emphasizes on the syllabus of the same course and the teaching depth of the same course in each school. It gives full play to their respective strengths, and discusses the preparation, presentation, and teaching design of the courses from various aspects, including the understanding of teaching contents, the grasp of teaching tasks, the selection of teaching means, and the organization of teaching activities^[8,9]. Teaching practice, with the assistance of network remote live broadcasting through listening, speaking, and evaluating a class, to achieve the purpose of demonstration learning, emphasizes on in-depth communication through after-school discussions in addition to building and sharing teaching resources, such as course videos, electronic courseware, and teaching cases^[10]. Teaching research cooperation actively explores teaching research in curriculum implementation, teaching methods, teaching means, and teaching evaluation. It jointly refines teaching research results and promotes the practice of these results in schools.

5. Construction achievements of virtual teaching and research center

In the construction of rail transit signal and control virtual teaching and research center, several achievements are expected to be achieved through three levels: exploration of “offline + online” teaching organization innovation mode, co-construction and sharing of teaching resources, as well as mutual promotion and cooperation of teaching and scientific research.

- (1) To build a rail transit signal and control cross-regional teaching and research team. Explore the joint operation mode of virtual teaching and research center in schools, among schools, and between schools and enterprises. Build a teaching team that is relatively stable with both school teachers and enterprise technicians to meet the needs of multilevel talent training for industrial development.
- (2) To form a set of guiding standards for the teaching quality of rail transit signal and control specialty. Based on the national standard for the teaching quality of automation and combined with the characteristics of professional talent training, a high-quality resource sharing database should be formed in the construction of the talent training scheme, syllabus, and curriculum resources, so as to gradually improve and strive to form teaching quality standards for the Rail Transit Signal and Control major.
- (3) To jointly build a number of teaching resources for core courses of the Rail Transit Signal and Control specialty. Rely on national teaching platforms such as “Innovative Experimental Area for the Training of Innovative Talents in Transportation Information” and “National Virtual Simulation Experiment Teaching Center for Rail Transit Information and Control” as well as scientific research platforms such as “Key Laboratory of Railway Four Electricity BIM and Intelligent Application in Railway” and “Centralized Engineering Laboratory of Railway Signal Control and Dispatching in Gansu

Province.” Giving full play to the advantages of the mutual promotion of teaching science, carry out teacher training and exchange, promote cooperation to build specialties, as well as jointly build and share high-quality online course resources, such as the foundation of rail transit signal, station interlocking technology, and section signal and train control technology.

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References

- [1] Di J, Hu X, Zhao N, et al., 2020, Relying on the Virtual Teaching and Research Office of Rail Transit Signal and Control to Promote Professional Construction. *Education and Teaching Forum*, 2020(46): 225-226.
- [2] Zeng J, Wu S, Zhang C, 2020, Virtual teaching and Research Office: Exploration on the Innovation of Grass-Roots Teaching and Research Organizations in Colleges and universities. *China University Teaching*, 2020(11): 64-69.
- [3] Sang X, Jia Y, Jiao J, et al., 2021, Theoretical and Practical Exploration on the Construction of Virtual Teaching and Research Room in Colleges and Universities. *China Higher Education Research*, 2021(11): 91-97.
- [4] Hu J, Chen H, Zhang J, et al., 2018, Relying on Virtual Teaching and Research Room to Improve Course Teaching Quality – Taking the “Double Training Plan” of Beijing Jiaotong University as an Example. *Beijing Education (Higher Education)*, 2018(05): 56-58.
- [5] Wang J, Dong M, Lou X, et al., 2017, Research on Innovative Teaching and Research Platform Based on Virtual Collaboration. *Education and Teaching Forum*, 2017(13): 161-162.
- [6] Wang M, 2021, Research on the Curriculum Construction of “Railway Signal Foundation” Relying on Virtual Teaching and Research Office. *Wireless Internet Technology*, 18(04): 123-125.
- [7] Zang Z, 2021, Research on the Reorganization and Transformation of Teaching and Research Departments in Colleges and Universities from the Perspective of Community, Heilongjiang University.
- [8] Chen H, 2016, The Way of Virtual Teaching and Research and Its Application. *China After School Education*, 2016(32): 11-12.
- [9] Sirazetdinov R, Kamalov A, Nikitina D, et al., 2016, IOP Conference Series: Materials Science and Engineering, June 2016: AR-601 Anthropomorphic Robot Modeling and Virtualization Toolset For Research And Education Purposes, IOP Publishing, 134(1): 012048.
- [10] Xia Y, 2014, On the Value, Mechanism Construction and Implementation Strategy of Subject Virtual Teaching and Research Office – A Case Study of Gaomi City, Shandong Province. *Contemporary Educational Science*, 2014(24): 26-30.

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