



Construction of Virtual Simulation Experiment Resources Based on Virtual Teaching and Research Section Under Digital Transformation

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Abstract. Virtual teaching and research section is a new form of grassroots teaching organizations in the era of digital economy, which provides important conditions for the construction of experimental practice courses with industry characteristics. Taking the construction of virtual simulation experiment teaching system for aircraft maintenance related majors as an example, this paper discusses the construction and application of virtual teaching and research section in collaborative development of virtual simulation experiments. Firstly, combined with the platform advantages of the cooperative cross-space-time teaching community, the feasibility and objectives of the construction of the virtual teaching and research section are discussed. Then, the construction effect of the aircraft virtual simulation experiment teaching system based on the virtual teaching and research section platform is analyzed and summarized from four aspects: the construction of the experimental system, the deep expansion of the experimental content, the breakthrough of the bottleneck of the experimental limitation and the hierarchical construction and promotion of the virtual simulation experiment platform. Finally, the construction is summarized, and the virtual teaching and research room is prospected.

Keywords: Virtual Teaching and Research Section, Aircraft Maintenance, Virtual Simulation, Experimental Teaching System.

1 INTRODUCTION

Practical teaching is one of the important indicators that distinguish vocational education from general education. It emphasizes the importance of practical teaching in education and teaching [1]. However, in the experimental and practical teaching of aircraft maintenance specialty in civil aviation universities and education and training institutions outside the industry, there are many problems in the physical experiment of aircraft maintenance specialty, such as airworthiness limitation, high cost, difficulty in simulating faults, and difficulty in deepening parts, which cannot support the needs of

Section(VTRS) and the development of virtual simulation technology provide new opportunities and solutions for the construction of experimental teaching system with industry characteristics.

On the one hand, VTRS is a new teaching form produced by deepening the new teaching reform with the support of digital technology. It is a virtual basic teaching organization or unit for interdisciplinary, cross-industry and cross-regional teaching, scientific research and industrial deep integration and collaborative education [2-3]. This new teaching form is in line with the characteristics of innovation, cross-border and collaborative integration of experimental practice curriculum construction of aircraft maintenance related majors, and provides a new platform support for the construction of experimental practice curriculum system.

On the other hand, virtual simulation technology, as a new technology that uses computer technology to simulate the real world, can enable students to operate, experiment, and practice in a virtual environment by simulating real scenes, things, and people. It has a series of advantages such as high fidelity, strong interactivity, high security, and strong flexibility. It is more and more widely used in educational informatization, providing the possibility for building deep-level experiments and breaking through real teaching problems [4-5].

2 VIRTUAL TEACHING AND RESEARCH SECTION CONSTRUCTION

2.1 Construction Feasibility of VTRS

The major of Electronic Information Engineering (Avionics and Electrical Direction) in Civil Aviation University of China belongs to the unique specialty of civil aviation. It is a national first-class undergraduate specialty construction point and the International Aviation Education Committee (AABI) certification specialty. The specialty originated from the aviation instrument and aviation radio specialty when the school was established in 1951. In recent years, great progress has been made in professional reform and construction. A perfect professional talent training system has been constructed, which is in line with the international certification system of aviation and the integration of production, teaching and research. A series of experimental and training platforms have been formed, and the universal professional construction experience has shown a good demonstration role in the industry and among brother colleges.

At present, the country is vigorously developing civil aviation education and training, and a large number of colleges and universities offering aviation electronics and electrical majors have emerged. Colleges and universities need cooperation and exchange in professional construction, experimental training equipment, curriculum resources, teacher construction and teaching experience. Therefore, on the basis of the entity teaching and research section of our school, the joint construction of the colleges and universities inside and outside the industry that set up this characteristic specialty will further explore the coordinated development of the related specialties of the national aircraft maintenance on the basis of the existing cooperation.

2.2 Construction Goal of VTRS

Based on practice and relying on the industry, the virtual teaching and research section intends to build a high-quality professional standard system, reserve high-quality teaching resources, form a multi-collaborative talent training community of aviation electronics and electrical guided by international aviation education standards, shoulder the important task of civil aviation power, and provide ideas for the construction of virtual teaching and research section of industry specialty.

1. Optimize the training standards of civil aviation characteristic professional talents, and ensure that the professional construction is 'good rules to follow'.

2. Explore data-driven online teaching and research activities to achieve teaching seminars 'evidence-based'.

3. Build a high-quality resource library of civil aviation characteristic professional courses + practical courses to ensure that teaching resources are 'excellent materials'.

4. Famous teachers lead, industry experts help, to achieve teacher training 'easy to reach'.

3 CONSTRUCTION PRACTICE OF AIRCRAFT VIRTUAL SIMULATION EXPERIMENT TEACHING SYSTEM

In recent years, the industry has carried out explorations such as old equipment renewal, virtual maintenance equipment, and training simulation experiments for CDIO and new engineering disciplines [6-9], which have solved the problems of real aircraft models and high experimental teaching costs. However, there are still some deficiencies in the development of comprehensive inquiry experiments, the implementation of online courses, and evaluation management. Aiming at these problems, through in-depth inter-school cooperation and collaborative construction, four member units of VTRS such as Nanjing University of Aeronautics and Astronautics have carried out the construction and practice of teaching reform based on the experimental development platform of 'Internet + virtual simulation', focusing on the improvement of the experimental system, the in-depth expansion of the experimental content of the integration of production and education, and the development of high-level experiments.

3.1 Construction measures of experimental teaching system

Construct Three Layers and Six Kinds of Virtual Experiments to Solve the Problem of Imperfect Experimental Teaching System. The experiments of avionics system professional courses are set up separately, with different levels and lack of effective connection, which is not conducive to cultivating students' comprehensive engineering application ability. Taking the improvement of civil aviation safety maintenance post competence as the core, taking the three-level ability training of 'basic cognition, comprehensive practice and innovative design' as the main line, referring to the CCAR-147 practice training project, according to the training law of engineering practice talents,

the step-by-step practice system of six types of experiments, namely ' component position identification, functional test / operation test, ground service / operation, disassembly and installation, troubleshooting and electronic accessory repair ', is constructed to create a three-level virtual experiment of ' specialty-university-country '. The three-level experimental system is shown in Fig 1.

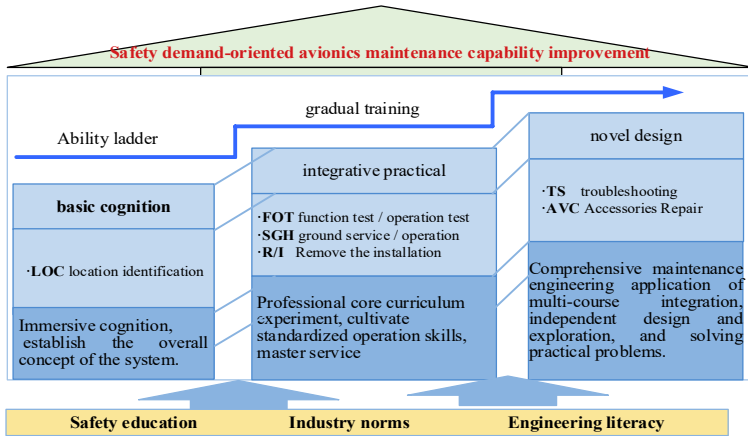


Fig. 1. '363' progressive experimental system architecture

Construct a Comprehensive Design Virtual Experiment of Multi-course Integration to Solve the Problem of Insufficient Depth of Experimental Content. The physical experiment is mainly based on the cognitive recognition and operation verification of the airborne system, which is difficult to support the cultivation of aviation core capabilities such as ' comprehensive application of knowledge, identification of professional problems in the field of avionics, proposal of solutions and implementation '.

A comprehensive design experiment content with ' avionics system fault diagnosis and measurement ' as the main line is constructed. Experiments such as airborne equipment air fault identification, ground fault diagnosis scheme design, route component-level fault isolation, infield avionics computer fault diagnosis, equipment internal board circuit analysis, etc., are carried out. The project concepts such as scheme design, test debugging, analysis and improvement are integrated into the experiment, which effectively improves the high-order, innovation and challenge of the experiment.

Using ' Internet + virtual ' Simulation Technology to Solve the Problem of Difficult Implementation of Real Teaching. The physical experiment is limited by factors such as airworthiness restrictions, high cost, difficult to simulate faults, and difficult to penetrate inside components. It is difficult to run the whole machine and carry out high-level experiments, which is the bottleneck of cultivating high-level talents.

Using the advantages of ' Internet + virtual ' technology, Unity3 D is used to build a virtual experiment development platform independently, which visualizes, visualizes and virtualizes the complex airborne system and its components online. The closed-loop mode of " design-development-use-feedback-modify design " is adopted to realize

the experimental system of "realistic demonstration, interactive verification and creative design" of airborne system.

To Open Up the Inter-school Virtual Experiment Teaching to Build a Channel to Build a National Virtual Teaching and Research Platform. Each university has its own advantages in the construction of experimental teaching. However, due to regional restrictions, experimental resources are difficult to share radiation in other universities, and it is difficult for experimental teachers to communicate and collaborate.

Therefore, relying on the national virtual simulation experiment teaching course sharing platform-experimental space, open and share high-quality experimental courses to other colleges and universities; at the same time, relying on the national VTRS platform, focusing on the goal of improving the practical ability of industry talents, the member colleges and universities have explored online teaching and research that break through the limitation of time and space, complement each other's advantages, learn from others' strengths, and jointly build high-quality experimental teaching resources.

3.2 Construction Achievements and Application Promotion of Experimental Teaching System

The national virtual simulation experiment teaching course sharing platform is on-line, and the construction results are recognized by many parties. The results were supported by the Tianjin virtual simulation experiment teaching construction project. Two virtual simulation experiment projects were launched on the 'National Virtual Simulation Experiment Teaching Course Sharing Platform', which was fully open to the society. 'Virtual Simulation Experiment of Outfield Maintenance of Aircraft Avionics System' has been approved as a national first-class course of virtual simulation experiment teaching.

Relying on the virtual teaching and research platform, build a virtual simulation experiment. With the support of the virtual teaching and research section platform, multi-schools jointly build and share open virtual simulation experiment projects. Aiming at the differentiated needs of colleges and universities, six virtual simulation experiment projects have been developed in cooperation with Nanjing University of Aeronautics and Astronautics, Shanghai Civil Aviation Vocational and Technical College, Chengdu Aeronautical Vocational and Technical College and other colleges and universities.

Member units to promote, the application effect of the initial highlight. The results are exchanged and promoted in the member units of the virtual teaching and research section, such as Nanjing University of Aeronautics and Astronautics, Shanghai Civil Aviation Vocational and Technical College, Chengdu Aviation Vocational and Technical College, Binzhou College, Yantai Nanshan College, Shaanxi Industrial Vocational and Technical College, Shijiazhuang Engineering Vocational College and other

colleges and industries. It has effectively supplemented the problems that cannot be carried out in the physical experiment, and has been recognized by the teachers and students. It has been recognized in terms of interactivity, fitting the reality of aviation maintenance engineering, stable operation, standardized operation and innovative thinking. And many times in the virtual simulation related experimental teaching seminar with the experts on the virtual experiment content and teaching methods were exchanged. The promotion case is shown in Fig 2.



Fig. 2 External school promotion-use virtual simulation experiment

Analysis of the teaching application effect of virtual simulation experiment. After three years of promotion and use, the virtual simulation courses have supported 1639 people, 7170 browsing times as shown in Table 1.

Table 1. Experimental data of national level virtual simulation first-class courses

Views	Experimental participants	Number of participants	Average experimental time	Experimental completion rate	Experimental pass rate
7174	1639	1476	68mins	97%	92.6%

In the use of the latest semester, the learning effect was investigated through the questionnaire star. Result showed that 96.4 % of the students said that the virtual simulation experiment was novel and more interesting than the field experiment. 97.1 % of the students approved the new experimental teaching method of virtual simulation experiment. 95.2 % of the students said that the virtual simulation software had a high degree of restoration, which increased the real feeling of visiting the airline maintenance site. 85.3 % of the teachers said that with the help of the data of the virtual simulation training platform, they can understand the students' learning situation and needs in time, so as to adjust the teaching strategies and methods in time and improve the teaching quality and efficiency.

4 CONCLUSIONS

After four years of construction and practice, based on the virtual teaching and research platform of electronic information engineering specialty (avionics and electrical), 26 'specialty-university-country' three-level virtual simulation experiment projects have been built through collaborative teaching and research, and two virtual simulation experiment projects have been launched on the 'national virtual simulation experiment teaching course sharing platform' and are fully open to the society. The results have been promoted and used in 4 member units of the teaching and research section and other colleges and universities, which has effectively improved students' design thinking ability, knowledge integration and application ability, engineering practice ability and innovation and entrepreneurship ability, and more than 10,000 teachers and students have benefited.

In the future, it is still necessary to continuously improve and continue to work in the aspects of curriculum ideological and political education, combination of science and education, and international cooperation, so as to continuously deepen the application of data platforms and new technologies to promote the high-quality development of education, improve students' engineering practice ability, and meet the requirements of industry post requirements and professional training objectives for talent training.

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