

Research on Virtual and Reality Cooperative Experiment Teaching of Electric Drive Course Group Engineering

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Abstract: The CDIO (Conceive, Design, Implement and Operate) teaching mode and virtual simulation experiment platform of professional courses were established, four kinds of simulation experiments were designed, from easy to difficult, through the integration of production and education and the coordination of virtual and reality. The engineering project adopts top-down modular disassembly. Modular building blocks are built from bottom to top in the course, and the connection between modules is completed step by step, from point to surface and from surface to body to complete the engineering design and realize the whole process of CDIO engineering. Through the implementation of integrated teaching process, students can expand free design, stimulate innovative thinking, and integrate professional knowledge systematically with the relevance of engineering projects, which provides a certain support for engineering education.

Keywords: Course group; Virtual and reality auxiliary; CDIO.

1. Introduction

With the rapid development of science and technology and the rapid penetration of artificial intelligence technology, the automation major has the characteristics of interdisciplinary integration and essential application in an intelligent system. Students trained by automation major need to follow up on social and technological progress in time and have good engineering innovation and application ability.

With the development of information technology, AR technology and communication equipment, people's demand for the diversity and globalization of learning content and learning ways is also increasing. Network learning develops rapidly. Although it satisfies people's constant supplement of knowledge learning, the boring network teaching and the isolated teaching mode among courses also highlight many deficiencies [1].

Currently, most of the theoretical classes in colleges and universities are still in the traditional classroom mode, and there is a lack integration among various courses. Students can not connect all links in the simple closed-loop control system of engineering, lack engineering concepts, do not integrate the knowledge they have learned into engineering design, and lack of immersion, interaction and interest in learning.

Experimental and practical courses mainly focus on two-dimensional interactive interface design, which has some shortcomings such as unattractive experimental effect, single human-computer interaction mode, and inability to run cross-platform. It is not vivid and intuitive. In particular, for the courses of applied engineering majors, actual engineering models and objects cannot be shown in class, and students lack engineering knowledge and experience [2].

Given the above problems, this paper introduces virtual simulation technology to maximize the use of software and hardware resources in teaching. It adds virtual simulation experiments based on the traditional experimental platform model. Virtual reality cooperation can help students have a

more perceptual understanding of the actual working conditions while training their hands and thinking ability to firmly grasp important knowledge points.

Different from the experimental platform mode, students can play freely to stimulate their innovative consciousness and ability without considering the damage to devices and instruments caused by mis operation. Students can realize relevant circuit design and software simulation by consulting various resources and materials and then build hardware circuits to complete system debugging, operation, summary and analysis. Improve students' practical ability and independent thinking ability step by step with engineering awareness to help students build self-confidence, and be brave to explore and practice.

The virtual reality collaborative experimental platform can organically combine theoretical and practical teaching, and transform more into an applied and comprehensive teaching mode [3]. Virtual reality collaboration can strengthen students' understanding and application of theoretical knowledge in practical application, stimulate students' interest and enthusiasm in learning, cultivate students' ability to analyze and solve practical problems independently, and enhance engineering awareness.

2. The idea of virtual reality collaboration course group construction based CDIO

Since the introduction of the CDIO engineering education model in China in 2005, it has profoundly influenced on China's engineering education [4-6]. Conceive, Design, Implement and Operate (CDIO). It takes the whole life cycle from product research and development to product operation, maintenance and abandonment as the carrier, establishes an integrated mutually supportive and organically linked curriculum system, integrates professional knowledge, ability to achieve, quality and other training objectives into the teaching, so that the educates can learn engineering actively

and practically.

The whole experiment platform and teaching reform, to automation industry demand as traction, research feeding teaching. Select engineering projects suitable for training applied talents, and take them as the main line to organically combine learning, research and practice for integrated training. With a student-centered approach, it integrates ideology and politics with science. While completing basic courses, it gradually meets engineering design ideas and

professional standards and carries out independent innovation. Accelerate the implementation of innovation-driven development, establish the CDIO teaching model of this professional course group, integrate production and education, and cooperate with virtual and real to realize the whole process of engineering CDIO [7]. At the same time, a multi-dimensional evaluation and feedback platform is established to recognize the closed-loop cultivation of talent training and social collaborative innovation transformation, as shown in Figure 1.

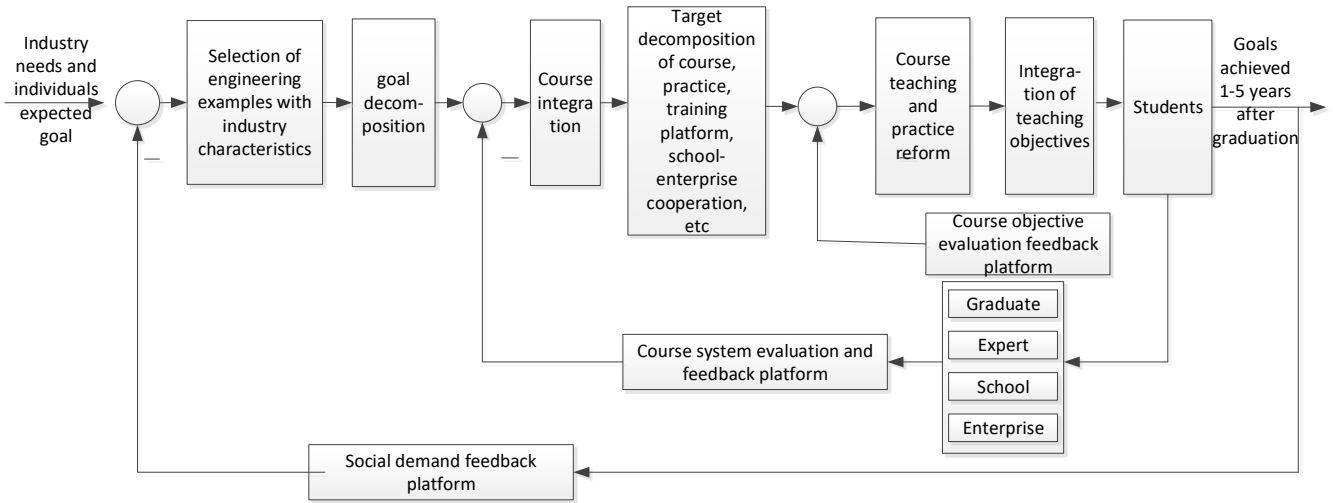


Figure 1. Platform Construction Ideas and Closed-Loop Culture Block Diagram

Set up mutually nested, interrelated, and mutually supported curriculum systems and establish an integrated cloud, network and terminal system. Through the implementation of an integrated teaching process, students can acquire learning ability, interpersonal skills and the ability to build products, processes and systems while learning professional knowledge to integrate professional knowledge systematically with engineering projects.

By raising questions - designing experiments - data analysis - drawing conclusions and other links, the project can be changed from C (conception), D (design), I (manufacturing) to O (completion). Follow the principles of "from shallow to deep, from concrete to abstract, and from simple to complex" to design the relationship between projects and courses, and form an integrated multi wing teaching model. Provide a platform for students to use, activate and relate knowledge creatively, cultivate students' ability to learn independently, find problems, solve problems and think creatively, and integrate knowledge and ability together. Six courses were initially selected for construction, and closed loop control was formed between courses, as shown in Figure 2.

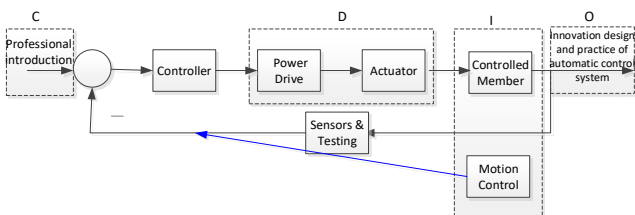


Figure 2. Block Diagram of Closed Loop Training of Course Groups Based CDIO

Starting from the system input, the consciousness of engineering innovation is throughout, and the learning of engineering cases is completed step by step, so as to fully mobilize the enthusiasm of each student to participate in

CDIO teaching, so that students can master the ability and attitude of independent learning.

The CDIO teaching and experimental platform mode of a single course should be changed, and the CDIO teaching and shared experimental platform of electrical transmission course groups should be established [8]. Through projects, the organic connection of professional course groups should be realized and the teaching mode of gradually understanding and re-understanding should be realized, so that students can personally experience the working history of professional engineers and quickly adapt to society and lay a solid foundation. The CDIO-based electrical transmission course group construction and experimental platform design are shown in Figure 3.

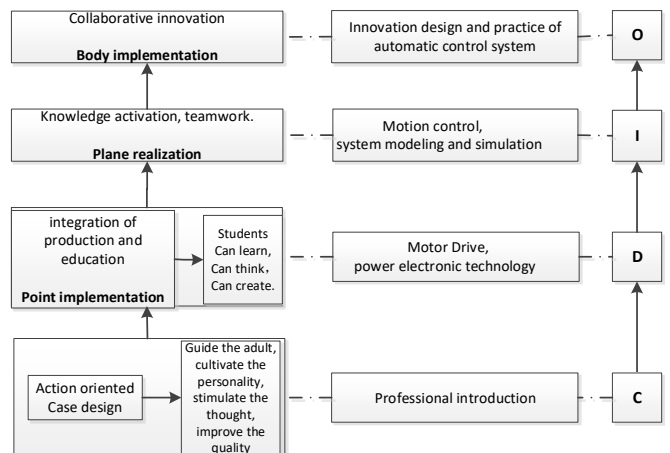


Figure 3. Design of Experimental Platform Based CDIO

3. Reform measures of virtual and real cooperative course group construction

According to the previous theoretical research and experimental operation, combined with the problems in actual teaching, the virtual interaction center is developed, divided into three modules: teacher and student question answering, exploration and learning, and knowledge sharing, to strengthen online and offline interaction.

Based on system demand analysis, the hierarchical structure of interactive electric drive control course teaching system is analyzed and designed. In software, 3D model rendering, interactive control of 3D model and autonomous roaming of 3D scene need to be realized. The composition of virtual and real co-simulation teaching system of course group is shown in Figure 4.

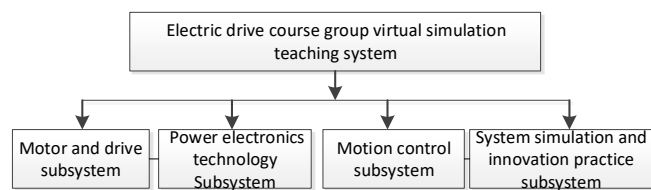


Figure 4. Composition of Virtual Simulation Teaching System Of course Group

The application development of the whole project is completed step by step on the experimental platform. Based on MATLAB, Solidworks, C4D and other professional virtual simulation software, a simulation platform is built, and four types of simulation experiments are designed, from simple to profound, from easy to complex, so that students can

successfully master the knowledge they have learned. The experimental project module is disassembled from top to bottom, and the project runs through the entire experiment. The experimental modules are built from bottom to top, and the connection between each module is completed step by step. The four-dimensional experimental model is a combination of "demonstration and verification", "research", "integration" and "independent design", which gradually transitioned from point to surface, to body, to theme. In terms of knowledge, scientific learning is carried out in a progressive way from basic theory to comprehensive application, which enriches the content of experimental teaching, expands free design, deepens engineering design idea and stimulates innovative thinking.

4. Reform practice of virtual and real cooperative course group

In this teaching reform, virtual simulation technology is used to add virtual simulation experiments based on the traditional experimental platform model, and virtual-real collaboration is carried out to extend the "experimental platform model" of a single course to the testing platform of course groups throughout the engineering cases. The empirical mode combining "verification", "research", "comprehensiveness" and "independent design" has enriched the content and means of experimental teaching in the gradual transition from point to surface to volume. The following only take the motor and drag subsystem as an example and briefly give our construction ideas. These are shown in Figure 5 and Figure 6.

Motor characterization and motion control virtual simulation system	
<input type="button" value="Motor selection"/> <input type="button" value="Synchronous motor simulation"/>	
DC motor experiment <input type="button" value="Experiment 1: Learn about motor"/> <input type="button" value="Experiment 2: DC motor"/> <input type="button" value="Experiment 3 Working characteristics of DC motor"/>	Transformer experiments <input type="button" value="Experiment 1 Single-phase transformer"/> <input type="button" value="Experiment 2: Three-phase transformer"/> <input type="button" value="Experiment 3 Three-phase transformer coupling group"/>
AC motor experiment <input type="button" value="Experiment 1 Working characteristics of three-phase squirrelcage asynchronous motor"/> <input type="button" value="Experiment 2 Starting and speed regulation of three-phase asynchronous motor"/> <input type="button" value="Experiment 3 M-S curve mapping of asynchronous motor"/>	Innovative design <input type="button" value="Design 1 a dual-loop PID-controlled first-order inverted pendulum control system"/> <input type="button" value="Design 2 Double closed-loop control DC motor speed regulation system"/> <input type="button" value="Design 3 Innovative design and practice of two-wheel balance bike"/>

Figure 5. Virtual Experiment Design of Motor and Drive Module

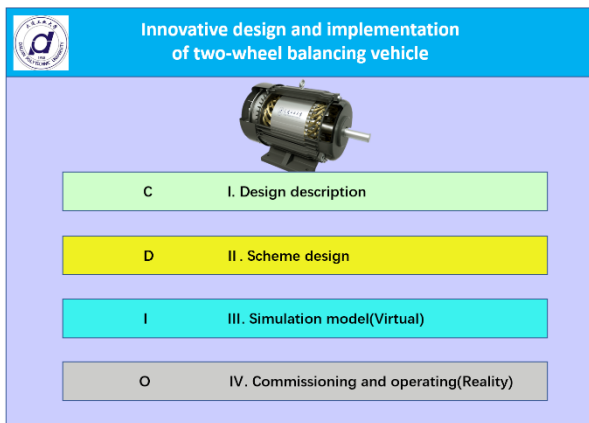


Figure 6. Implementation Scheme of CDIO Application Innovation Design

The virtual simulation technology is used to build an experimental platform, which breaks through the limitations of traditional experimental teaching, greatly expands the connotation and extension of experimental teaching, and solves the problems such as limited types and numbers of experimental platforms, less experimental time, abstract theory teaching, and the theory cannot be effectively linked with practice. Cultivate students' practical ability, comprehensive application ability, engineering design and innovation ability. Firmer grasp of the basic knowledge, and flexible use in practice, according to the design requirements of engineering and process of high quality to complete the automatic control system innovation design and training.

This simulation platform liberates the students from the complicated manual calculation, so that the students have more time to think about the basic concepts and basic methods; The abstract and difficult concepts and results in the course are presented by using the computer, which greatly improves the teaching quality and efficiency.

The teaching quality assurance system is also constructed according to the four levels of CDIO, forming a multi-dimensional evaluation and feedback platform, which can receive the feedback information from students on time, and realize open school running and closed-loop training.

5. Conclusion

This paper analyzes the current teaching mode of most colleges and universities, conducts an in-depth investigation on the current development status of virtual reality technology and the distribution of educational resources, and develops virtual-real collaborative teaching courseware and experimental platform based on the CDIO concept. It takes the integration and decomposition of practical engineering projects as the line. The key courses of the electric drive control system shall be scientifically and cooperatively integrated, combining virtuality and reality, highlighting the cultivation of technology application and innovation ability, strengthening the ability to solve practical problems on the engineering site, building technology-led virtual simulation experiments, applying more cutting-edge technologies into

this project, taking into account the universality and advancement of technology, and strengthening the integration of skills and teaching. Make the program more adaptable to the requirements of practical teaching; Build a public service platform for sharing; and push and update relevant principles, knowledge, videos and other resources in real-time.

The extensibility and portability of the platform are good, which can be extended to other courses. The subsequent development of multi-disciplinary virtual teaching platform can be carried out. The combination of virtual and practical can not only solve the problems of lack of experimental resources and experimental funds in the field of education, but also provide more students with the opportunity of exploratory experiments, and improve learners' ability of independent innovation and problem finding and solving, which is of great significance for innovative applied talents.

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