

# Reform and Practice Path of Teaching Mode of Automatic Control Principle Course in School-enterprise Cooperation in Application-oriented Universities

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**Abstract:** The principle of automatic control is one of the core courses of application-oriented higher education. However, due to the increasing demand for professional skills and practical ability in business circles, the educational model is also facing the pressure of keeping pace with the times. Based on this, this paper first expounds the value of the reform of the teaching mode of automatic control principle of school-enterprise cooperation in application-oriented universities, then analyzes its theoretical framework, and finally puts forward the practical path of the reform of the teaching mode, which also provides valuable reference for the continuous optimization of the future education mode.

**Keywords:** school-enterprise cooperation; Automatic control principle; Curriculum teaching mode; Reform practice path

## 1. Introduction

With the rapid development of science and technology and the continuous improvement of industrial automation, the demand for automatic control technical talents is becoming more and more urgent. This demand is strongly reflected in the teaching practice of application-oriented universities. Application-oriented universities have stronger career orientation and applicability, and their curriculum and teaching methods should be closer to reality and more targeted. Therefore, it is an important and urgent task to explore how to reform the teaching mode of automatic control principle course in application-oriented universities through school-enterprise cooperation, so as to better meet the needs of industry and society.

## 2. The value of the reform of the teaching mode of automatic control principle course in school-enterprise cooperation in application-oriented universities

### 2.1 Improve the docking degree between courses and industries

Cooperation with enterprises enables universities to understand the needs of the industry more accurately, so as to adjust the teaching content, including practical tools, technologies and processes, to adapt to the practical application in the industrial field. This practice not only strengthens students' understanding of the relationship between theoretical knowledge and practical application, but also improves their professional quality. Through further internship and practice opportunities provided by enterprises, students can apply their knowledge in the actual working environment, and further enhance the interaction and docking between courses and industries. This will not only help students better adapt to future jobs, but also greatly improve their employment competitiveness. At the same time, enterprises participate in the curriculum design and teaching process, which also provides teachers with a rare opportunity to contact and understand the latest technology and needs of the industry. In this way, teachers can integrate the latest industry trends and technology applications into the curriculum, thus making the curriculum content closer to reality, more targeted and forward-looking. Therefore, through school-enterprise cooperation, the docking degree between the course of automatic control principle and the industry can be obviously improved, so as to better serve the students' career development and the continuous progress of the industry.

## ***2.2 Promote the development of students' practical ability***

School-enterprise cooperation can provide students with abundant practical platform and resources. In close cooperation with enterprises, colleges and universities can organize targeted practical activities and projects, so that students can apply automatic control principles in situations similar to real working environments, thus improving their ability to solve practical problems. Business experts and technicians often participate in teaching as guest lecturers or consultants, and their practical experience is an excellent supplement to students. Such communication activities can not only broaden students' professional horizons, but also refine their professional skills in practical application. School-enterprise cooperation can also promote the closer combination of curriculum teaching and actual industrial needs. While mastering the basic theory, students can apply their theoretical knowledge to actual production and technical improvement in time by means of enterprise practice and subject research, so as to develop their practical ability more comprehensively. This cooperation mode also helps students to establish good professional concepts and teamwork ability. Through cooperation with enterprises, students can not only train their technical application ability, but also train their team cooperation and professional communication skills in practical projects.

## ***2.3 This contributes to the professionalism of teachers***

In-depth cooperation between teachers and enterprises can enable them to grasp the latest developments and technical requirements of the industry more accurately, so as to integrate more contents closely related to practical application into teaching. This can not only increase the practicality of the curriculum, but also help teachers to improve their professional ability. Teachers can learn practical professional knowledge and skills directly from enterprise experts and practitioners through enterprise internships, seminars and training courses, so as to further improve their teaching quality. This kind of professional interaction and learning can effectively broaden teachers' knowledge fields and enrich their teaching methods. Strengthening teachers' professional quality is also helpful to enhance students' sense of identity and satisfaction with the curriculum. When teachers can teach in a more professional and grounded way, students can understand and master complex theoretical knowledge more easily, thus participating in the curriculum more actively. The improvement of teachers' professional quality will also promote the development of the whole teaching team. Teachers can share the new knowledge and experience gained from enterprise cooperation with other teachers, so as to improve the teaching quality and professional level of the teaching team as a whole.

## ***2.4 Optimize teaching resources and management processes***

In terms of teaching resources, application-oriented universities and enterprises can share hardware equipment, software platform and teaching materials, which makes teaching resources richer, newer and more practical. For example, enterprises can provide the latest experimental equipment and software licenses to support experimental teaching in schools; Schools can provide theoretical basis and research support, and the two sides complement each other. The introduction of information technology can automate many tedious management tasks, such as attendance records, performance management and curriculum allocation, so that teachers have more time and energy to devote to classroom teaching and individual tutoring of students. At the same time, the student management system can also track students' learning progress and performance, and provide teachers with timely and accurate data support, so as to make targeted teaching adjustments. By building a sharing platform within teachers, teachers can easily share teaching resources, teaching experiences and successful cases, and also put forward their own problems in teaching and seek advice and help from peers. This not only promotes the professional communication and cooperation among teachers, but also improves the overall ability of the teaching team.

## **3. The theoretical framework of curriculum teaching reform**

### ***3.1 The integration of production and education theory***

The theory of integration of production and education mainly includes several key building elements: demand identification, resource integration, interactive feedback and continuous optimization. At the level of demand identification, the theory of integration of production and education emphasizes close communication and investigation with enterprises and industries to clarify their specific needs and skill

standards for professionals, which provides data support for the design of curriculum content. In the aspect of resource integration, this theoretical model advocates the mode of school-enterprise co-construction. Educational resources (such as teachers, courses, teaching materials, etc.) and enterprise resources (such as experimental equipment, practical projects, industry data, etc.) are effectively integrated to realize the seamless connection between teaching and practice. In the interactive feedback link, the model pays attention to establishing a multi-party evaluation and feedback mechanism. Through regular examination, evaluation and enterprise feedback, the curriculum and teaching methods can be adjusted in real time to adapt to the changing market demand and technological development. At the level of continuous optimization, the theory of integration of production and education emphasizes a dynamic, continuous process of renewal and improvement. With the help of data analysis and case studies, the teaching mode and content will be carefully adjusted and optimized according to the actual effect and feedback. With its systematicness and operability, this theory provides a set of perfect and highly adaptable theoretical guidance in the teaching mode reform of automatic control principle course in application-oriented universities. Therefore, deep understanding and application of this theoretical model has important guiding value for curriculum teaching reform.

### ***3.2 Project-based learning (PBL)***

Project-Based Learning (PBL for short) is a student-centered teaching method, which aims to promote students' problem-solving ability, critical thinking, teamwork and autonomous learning ability by involving them in complex and practical projects [1]. This method is especially suitable for applied science, engineering, business and other fields that require practical operation and practical application. In the teaching mode of PBL, the role of teachers has changed from the traditional "knowledge transmitter" to "guide" and "coordinator". Teachers need to design and plan projects, but students are mainly responsible for the implementation, management and completion of projects. This method is helpful for students to absorb and apply theoretical knowledge from practical operation. Several key elements of project-based learning include: clear questions, student autonomy, interdisciplinary application, teamwork, feedback from teachers and peers, and final project presentation or results. Through these elements, PBL can encourage students to integrate knowledge and skills of different disciplines and solve practical problems. This teaching method also emphasizes reflection and self-assessment. After the project is completed, students and teachers will jointly evaluate the success of the project, as well as the problems encountered in the process and solutions. This can not only improve students' reflective ability, but also provide valuable experience for future projects. Project-based learning is a highly dynamic and interactive teaching method, which is suitable for various disciplines and educational levels, especially in application-oriented universities and vocational education.

### ***3.3 Problem-oriented teaching***

Problem-Based Learning (PBL for short) is a problem-based teaching method, which emphasizes students' autonomous learning and group cooperation. In this mode of teaching, students are usually assigned a specific, practical problem or case, and they need to find a solution through research, discussion and cooperation [2]. In problem-oriented teaching, teachers will provide an open question, and then guide students to find relevant information and resources to solve this problem. This teaching mode emphasizes students' initiative and participation, not just the passive process of receiving knowledge. Problem-oriented teaching often requires interdisciplinary cooperation, because problems in real life are often not solved by a single discipline. Students need to apply knowledge and skills in different fields to problem solving. This can not only enhance students' multidisciplinary comprehensive ability, but also improve their critical thinking and problem-solving ability. Compared with the traditional teaching mode, problem-oriented teaching pays more attention to the process than just the result. This means that students' performance should be evaluated not only by whether the answers they find are correct, but also by whether they can use effective methods and logical thinking in the process of solving problems. Problem-oriented teaching is a student-centered teaching method, which emphasizes practical application and comprehensive ability training.

#### **4. The reform and practice path of the teaching mode of automatic control principle course in school-enterprise cooperation in application-oriented universities**

##### ***4.1 Focus on the needs of enterprises and optimize the course content***

In the course of automatic control principle in cooperation between application-oriented universities and enterprises, it is necessary to focus on the needs of enterprises to optimize the course content. School should work together with the technical team and human resources department of the cooperative enterprise to form a course content research and development team. Through multiple meetings and discussions, a curriculum that is highly relevant to real-world industry practices is established. For example, if the partner is primarily involved in manufacturing automation, the course should focus on PLC programming, sensor applications, and robotics. Taking specific engineering projects or production lines as the background, practical cases are set up to form a teaching case base. These cases should start from the actual problems of enterprises, such as fault diagnosis and optimization of production processes. Students need to solve these real-world problems in class or homework in order to better apply theoretical knowledge. School can also invite engineers or experts from enterprises to come to school regularly to give special lectures or workshops. In addition to providing theoretical guidance, these experts can also share practical operation experiences such as configuration, debugging and maintenance of automatic control systems in enterprises [3]. Develop simulation environment and virtual laboratory together with enterprises. Through these simulation environments, students can test and verify various control algorithms without affecting actual production. Through these measures, the course content will be closer to the actual needs of enterprises, thus effectively optimizing the teaching objectives and contents.

##### ***4.2 To strengthen the project orientation, update the teaching mode***

Using project-based learning to decompose the course:-decompose the syllabus of automatic control principle course into multiple sub-modules or units. Each unit corresponds to a small project, which can be designing a simple PID controller, simulating a sensor network or establishing an automated process. Project Instructions: For each project, the instructor is required to prepare a detailed project instruction that includes project objectives, requirements specifications, a list of available resources, and evaluation criteria [4]. Team formation and role assignment: Students work as teams, and each team member has a clear role, such as "code developer", "project manager" or "document editor". Teacher's role change: Under PBL teaching mode, teachers mainly play the role of project consultant and evaluator. They provide critical guidance, such as regular project progress checks and lectures, but are not directly involved in project implementation. Students' independent exploration: Students need to conduct research, design and implementation according to the requirements of the project. In this process, students assign tasks, set schedules and solve problems independently. After the project is completed, comprehensive evaluation is carried out through the final report and project presentation. Feedback loop: After each project is completed, faculty, students, and possible third parties (for example, business partners) participate in a project review to discuss problems encountered and solutions.

##### ***4.3 The use of information technology to optimize teaching methods***

By using information technology to optimize teaching methods, the teaching process will be more efficient, and at the same time, it will provide more convenience and flexibility for teachers and students. Cloud teaching platform: Teachers can use Moodle, Blackboard or own platform for distributing teaching materials, publishing assignments and conducting online quizzes. In this way, teachers and students can access the course content and resources anytime and anywhere. Real-time interactive tools: With the help of Zoom, Microsoft Teams or other video conferencing software, online lectures and real-time discussions are conducted, and group collaboration or one-on-one consultation are also convenient [5]. Virtual laboratory: Using simulation software (such as MATLAB Simulink) or virtual reality (VR) technology to simulate the actual running environment of automatic control system. Students can carry out experiments without being limited by place and time. Automatic Grading System: Schools can develop or utilize existing automatic grading systems to automatically grade students' programming assignments or tests, saving teachers' time and providing timely feedback. Code sharing and version control: It is necessary to use code sharing platforms like GitHub, allowing students to submit project code for easy code review by teachers and tracking of change history. Mobile applications: Schools can develop or leverage existing mobile teaching applications, enabling students to access course content or complete quizzes on their smartphones or tablets anytime, anywhere. Data analysis:

The system should collect students' interaction data on the online platform, such as attendance and assignment completion, which is used to analyze students' learning activities and predict their grades.

#### **4.4 Diversified assessment methods to improve the evaluation effect**

The application of diversified assessment methods is to more accurately measure students' performance and mastery in the course of automatic control principles. Assessment objectives and targets: The school cooperates with companies so that the teaching objectives and the level of skills to be achieved by the students can be clearly defined. Based on these goals and indicators, the design includes written test, experiment, project and other assessment forms. Enterprise participation evaluation: Invite enterprise representatives to participate in the evaluation of student projects, or set up internship assessment links. The participation of enterprises can more accurately reflect whether students' skills meet the needs of the industry. Self-evaluation and peer evaluation: Introducing the mechanism of self-evaluation and peer evaluation, students can evaluate their own and classmates' projects or assignments. This evaluation method can improve students' autonomy and teamwork ability. Continuous optimization of assessment methods: According to the assessment results of each semester and the feedback from students and enterprises, the assessment methods are continuously optimized and adjusted. Optimization measures that can be taken include: adding new assessment contents, eliminating inefficient assessment methods, and adjusting the weights of each assessment link. Through these measures, we can have a more comprehensive understanding of students' performance in the curriculum, and at the same time, we can provide more targeted teaching feedback, thus improving the evaluation effect.

## **5. Conclusion**

In a word, application-oriented universities should carry out comprehensive reform on the teaching mode of automatic control principle through school-enterprise cooperation. Colleges and universities should focus on the actual needs of enterprises and optimize the curriculum content and teaching objectives; Project-based learning and problem-oriented teaching can be utilized to achieve a renewal of the teaching model; it is necessary to introduce information technology to improve teaching effectiveness; Diversified assessment methods and evaluation mechanism involving enterprises can improve the effect and quality of teaching evaluation. This series of reform measures not only promote the close combination of curriculum and enterprise needs, but also provide strong support for the improvement of students' practical ability and comprehensive quality, and promote the teaching mode of automatic control principle to develop in a more advanced and practical direction.

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