

# Construction of Independent Innovation Experiment System of Control Course Group

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## ABSTRACT

One of the important objectives of the teaching reform of the control course group is to change the traditional experimental teaching mode of verification into the design and innovation of the experimental mode combined with the actual engineering control object, according to the direction of modern teaching and experimental development, optimize the combination of practice content according to its internal connection, break the situation that each practice teaching link acts on its own, and pay attention to the level, relevance, gradualness and integrity of the curriculum within the curriculum group. Let students transition from the confirmatory experiment in the lower grade to the exploratory experiment in the higher grade, and from the operational and single experiment to the design and comprehensive experiment. Let the more excellent students create experiments or explore new solutions after completing the experimental content required by the program. Through the key training of students' innovation ability and hands-on ability, improve the students' innovation idea of integrating theory with practice and leading the project scientifically.

**Keywords:** *teaching reform, control course group, the design and innovation of the experimental mode*

## 1. INTRODUCTION

The original control course group experiments are mainly based on simulation experiment box experiments, which lack systematic control principles and control engineering experiments combined with actual engineering objects. As a result, students still lack practical understanding of the essence of control principles and control engineering after learning related courses and completing related experiments, and even cannot understand many basic concepts well, let alone apply the means and methods of control principle and control engineering to solve the problems existing in future engineering practice. One of the important goals of the teaching reform of control course group is to change the traditional confirmatory experiment teaching mode into the design and innovation experiment mode combined with the actual engineering control object, focus on cultivating the students' innovation ability and practical ability, and improve the students' innovation idea of integrating theory with practice and leading engineering scientifically<sup>[1]</sup>.

The experiment course, course design and graduation design of the control course group are indispensable links to cultivate students' independent working ability and comprehensive ability. The independent innovation experiment of control course group relies on control theory laboratory, automation innovation laboratory and artificial intelligence and intelligent control laboratory, which is the main link of training students to integrate theory with practice<sup>[2]</sup>.

The main courses involved in the control course group are: automatic control theory, digital simulation of control

system, digital control system, artificial intelligence, intelligent control, covering a wide range, and the independent and innovative experiments involve many advanced technologies in the control engineering discipline. In order to better complete the practical teaching of control courses, we must build a new experimental system of independent innovation<sup>[3]</sup>.

## 2. INTRODUCTION TO CONTROL COURSES GROUP

Curriculum group is a kind of curriculum construction mode corresponding to single course. It has been more than 20 years since the construction of curriculum group in domestic colleges and universities. In 1990, Beijing University of technology proposed to pay attention to the research and construction of "course group" (the early appellation of course group) based on "the overall optimization of teaching plan in the course construction". After that, some colleges and universities have carried out the practice of course group construction with the same or similar names but big differences. In order to reach a consensus and improve the quality of curriculum group construction, teaching administrators and teachers in domestic colleges and universities have carried out theoretical discussion on the connotation of curriculum group, among which there are five influential ones.

The course group is an organic integration of the integrated courses, which is guided by the modern education thought, and has mutual influence, interaction, order, and can constitute a complete teaching content system in the teaching plan.

The course group is based on more than one single course, which is composed of more than three single courses with related or similar nature. It is a chain type curriculum group with reasonable structure, clear level, mutual connection, cooperation and mutual reference among courses.

Curriculum group refers to a number of independent and closely related courses.

The curriculum group should be an organic whole composed of several series of courses which are closely related, inherited, infiltrated and complementary in content, equipped with corresponding teaching quality, and carry out curriculum construction according to the large curriculum framework, so as to obtain the overall advantages and create the discipline advantages.

The curriculum group should refer to the systematic curriculum group which belongs to a certain discipline, has a reasonable division of labor and can meet the teaching requirements of different majors.

It can be seen that the curriculum group has rich connotation. It is mainly reflected in the two attributes of curriculum group: one is relevance. Although the logical connection of knowledge, methods and problems among courses is the combination point of curriculum group, this connection is still implicit before the implementation of the construction of curriculum group. With the construction of curriculum group, this connection is constantly externalized, and promotes the students' cognitive transfer to achieve the penetration in the actual teaching. Second, integration. Through the re planning and design of the curriculum, the curriculum group fills in the gap between the original courses and removes the repetition between the original courses, which reflects the significance of one course to another course in the group, and enables students to better grasp the relationship between a course and other courses as well as the whole course group, so as to achieve the benefit of the whole greater than the sum of the parts.

### **3. RESEARCH STATUS OF INDEPENDENT INNOVATION EXPERIMENT SYSTEM**

In recent years, with the development of independent innovation education in the field of higher education, the cultivation of College Students' independent innovation ability as an important goal of laboratory construction is gradually recognized by the educational community in China. Many higher education researchers have begun to explore theoretically, and some university teaching managers have also launched positive practice from different angles. In the laboratory construction, the domestic teachers have done a lot of work, but most of them are scattered and unsystematic theories and opinions. There are still many problems in the traditional experimental teaching. The teaching method is single, and the modern teaching technology is not introduced into the experimental teaching; the teaching method is mainly teachers' teaching, and students passively follow the experimental guidance requirements and operation steps.

there is no interactive teaching method, and there is no extensive communication between teachers and students. Experimental teaching is mostly attached to theoretical teaching<sup>[4]</sup>, without an independent system; experimental content often lags behind the recent scientific research progress, and experimental teaching materials are updated slowly; there are too many confirmatory experiments, and less comprehensive, design, research and application experiments. General experimental courses do not count scores and do not have credits, which can not arouse enough attention of students; some experimental courses with separate students' performance evaluation lack of reasonable scientific basis<sup>[5]</sup>.

Laboratory opening is not complete, many laboratories have achieved the opening in time, but not enough in content; the traditional laboratory management system is rigid, which is not conducive to open experimental teaching. The experimental equipment investment is insufficient, the use efficiency of equipment and instruments is low, the laboratory idle rate is high, and the main battlefield of cultivating students' innovation ability is not fully played.

### **4. THE BASIC THINKING OF THE CONSTRUCTION OF CONTROL COURSE GROUP AND EXPERIMENT SYSTEM**

The construction of curriculum group should be centered on the cultivation of talents, focus on the optimization and integration of curriculum, focus on the reform of the teaching content, teaching methods and teaching means of curriculum group, guarantee the construction of the basic teaching conditions of curriculum group and the establishment of the evaluation system of curriculum group, keep pace with the times, and build a curriculum system integrating the teaching of knowledge, the cultivation of ability and the improvement of quality. Approve the curriculum group with school-based characteristics<sup>[6]</sup>. People oriented, the construction of curriculum group must focus on the cultivation of high-quality talents, take improving the quality of talent cultivation as the starting point and the foothold, which is conducive to enhancing the ability of students to find, analyze and solve problems, to cultivating students' innovative spirit and practical ability, and to the overall development of students' personality and talents.

#### ***4.1. Construction and development of teaching staff***

With the construction of course group as the carrier, with "integrating teachers, optimizing structure, supplementing quantity and improving quality" as the main line, with the construction of higher level teaching and scientific research echelon as the focus, with the deepening reform of innovation mechanism as the driving force, under the guidance of the concept of respecting labor, creation and

contribution, to build a teaching and scientific research work that can meet the development requirements of military colleges and Universities under the new situation, Teachers with noble morality, reasonable structure, excellent quality, relatively stable and full of vitality<sup>[7]</sup>.

At present, the teaching staff of our department can be divided into basic course group and professional course group according to the nature of the course, and can be divided into teaching course group, teaching research course group and research course group according to the level of the teachers<sup>[8]</sup>.

The construction of the basic course group should take the teaching type as the main goal, according to the general requirements of "at least 3 teachers for each course; each teacher can at least serve as 3 courses", focus on the cultivation of young teachers, "grasp the two ends, take the middle", introduce the external and internal training, carry out the construction of the teaching team of the basic course group, and form a teaching echelon with reasonable structure and high level; With teaching as the center, based on the teaching of professional basic courses group, vigorously carry out teaching research, and form a teaching research team with higher teaching research level.

#### **4.2. Revision and improvement of syllabus**

The construction of course group is different from the construction of a single course in that the construction of course system and the optimization and integration of course teaching content based on it are the important signs. The main advantage is that we can use the connection between adjacent courses in terms of time and content to compress the repeated content, reduce the number of course hours, and use the correlation of course content to support and strengthen each other to implement the construction of large courses. The teaching content of the principle of automatic control can be summarized as two systems and three analysis methods. Two kinds of systems refer to that the system studied in this course can be divided into continuous time system and discrete time system according to the objects it deals with; three kinds of methods refer to that the analysis methods used in the course can be divided into time domain analysis method, frequency domain analysis method and root locus analysis method. According to the needs of different majors, the teaching hours and contents of the course will be different. In order to increase the demand of some students of non-automation specialty for the depth of mastering control theory, we have opened two elective courses, introduction to automation and introduction to robotics. For students majoring in automation, courses such as "Introduction to artificial intelligence", "intelligent control" and "digital simulation of control system" are offered to further help them master the knowledge of control theory. Therefore, in the process of the construction of the course group, according to the requirements of the latest undergraduate training plan and the current development needs of each discipline, we

carefully examine the teaching content of each course, and revise the syllabus of each course in the course group.

#### **4.3. Specialization and localization of curriculum system construction**

Curriculum group construction is a process of curriculum integration and decomposition. Through the construction of the new curriculum group, we should update the content, more in line with the goal of talent training, and more reflect the characteristics of the school. In order to promote the implementation of the new curriculum group, we believe that we should focus on the localization of the curriculum system in combination with the professional background of our department for students. The reform of the course system mainly includes the following two ideas: (1) for the students of electrical and control categories, keep the original course system, update and add application examples, strengthen the application analysis in signal processing, control and other scientific fields, and broaden the students' vision; (2) for the students of communication, weapons, machinery and power categories, emphasize the use of PID control and other control methods, and reduce the number. Learn the solution and transformation of the model, strengthen the digital part, and preliminarily explain the state space method.

Redesign the experiment content and instruction. Based on the overall plan and construction objectives of the construction of control course group, the experiments of three courses of "automatic control principle", "control system digital simulation" and "intelligent control" can be combined into one experiment instruction. With MATLAB as the software tool, according to the knowledge structure after the integration of "control system digital simulation" and "intelligent control", the experiment content and its requirements, hardware experiment requirements and thinking, design experiment realized by simulation tools, etc.

### **5. CONCLUSION**

To study the construction method of control course group and experiment system, we must change the existing traditional teaching mode and experiment method, according to the direction of modern teaching and experiment development, optimize the combination of practice content according to its internal connection, break the situation of each practice teaching link acting on its own, and pay attention to the level, relevance, gradualness and integrity of the courses in the course group. Let students transition from the confirmatory experiment in the lower grade to the exploratory experiment in the higher grade, and from the operational and single experiment to the design and comprehensive experiment. Let the better students create their own experiments or explore new solutions after completing the experimental content required by the syllabus. Solid experimental teaching not only expands and

consolidates theoretical knowledge, but also lays a good foundation for curriculum design and graduation design.

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