

# *The exploration and practice of talent training mode oriented by highlighting practical ability*

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**Abstract:** In the context of the integration of science and education, in order to achieve the training goal of cultivating qualified high-quality innovative applied talents for society and enterprises, measurement and control technology and instruments combined with the scientific research advantages of scientific research institutes, the "2+2" academic system talent training model has been put forward and practiced to improve students' ability to solve complex engineering problems. This paper studies and practices from four aspects: the formulation of training program, the implementation of training program, the reform of teaching methods and the construction of teaching resources, the construction of professional ideological and political system and the construction of teaching staff, and explores the research on the "2+2 learning system" innovative talent training mode oriented by strengthening practical ability.

## 1. Introduction

With the acceleration of a new round of scientific and technological revolution and industrial transformation, the new generation of information technology integrates the Internet, big data, artificial intelligence, blockchain and other technologies, enabling the transformation and upgrading of traditional industries such as industry, agriculture, and medicine. In this context, the mismatch between the supply side of talents and the demand side of the industry is increasingly severe.[1] According to the survey data of the third-party organization of Max, the most prominent reflection of the surveyed enterprises is that the knowledge structure, practical ability and innovation ability of students are not enough to meet the specific requirements of the enterprise, especially the practical ability of engineering. According to internal and external needs and school positioning, the program of Measurement and Control Technology and Instrumentation has set the goal of training high-quality, innovative and applied talents in the field of national and local economic needs and major technical engineering development. How to improve students' practical ability and innovation ability and cultivate qualified innovative applied talents for society and enterprises is a problem that the major of measurement and control technology and instrument needs to solve.[2]

Around the Shandong Provincial Party Committee's requirements of "cultivating first-class disciplines, creating first-class platforms, gathering first-class talents, and producing first-class

results", Qilu University of Technology (Shandong Academy of Sciences) takes the integration of science and education as an opportunity, Form a new talent training system based on the deep integration of "college and research institute", Committed to promoting the major strategy of transforming old and new growth drivers in Shandong, Optimize the distribution and structure of higher education, Promote the high-quality development of disciplines and specialties.

In the context of the integration of science and education in the school, the major of measurement and control technology and instrument is based on the major strategic needs of national "Marine power" and Shandong Province "Marine strong Province". Relying on the characteristics and advantages accumulated in the past 60 years, with the direction of Marine measurement and control as its characteristics, the two-stage school-running talent training mode of "2+2 learning system" reflecting the advantages of science and education integration is adopted. This model fully integrates the strong research force of research institutes, gives full play to the respective advantages of colleges and institutes, and provides a strong guarantee for cultivating innovative talents. In the first stage (the first 2 years), the teaching unit will take the lead in the main campus of Jinan, and the institute will participate in the teaching of "general education courses + professional basic courses"; In the latter stage (the last two years), the Qingdao campus will be led by the professional research team of the Institute and the teaching units will participate in the course teaching of "professional-oriented courses + characteristic practice courses" to form a more scientific and reasonable "institution-integrated" talent training system [3].

In the specific implementation, through the "2+2" segment training, tutorial system, small class system, personalized and other new personnel training models, this training with solid professional knowledge, strong engineering practice ability and high innovation ability of composite measurement and control technology and instrument professionals, it has high specifications, high starting point to help the construction of a strong ocean province.

## **2. Strengthen the top-level design, formulate and improve the training program with distinctive Marine characteristics**

According to the professional training objectives, the major of measurement and control Technology and instrument standards the national standards for undergraduate professional teaching quality in ordinary colleges and universities, the general standards for engineering education certification and professional supplementary standards. On the basis of evaluating the achievement of the training objectives of graduates and employers, the major listens to the opinions of professional teachers and industry and enterprise experts, and after repeated argumentations, Determine the 12 graduation requirements for this major. [3] According to the graduation requirements, centering on the fundamental task of cultivating morality and educating people, combined with the suggestions of enterprise and industry experts, the course system is designed based on the concept of OBE. The entire course system can support all the graduation requirements, and each course can reflect its role in the course system.

In the process of developing the training program, we fully investigate the training programs of Ocean University of China and other schools, and integrate the knowledge of Marine technology on the basis of the original training programs of measurement and control technology and instruments, so as to realize the organic combination of electrical knowledge and Marine knowledge and highlight the characteristics of the ocean.

In order to strengthen design ability and innovation consciousness, promote the training of engineering practice ability and the ability to solve complex engineering problems, the specialty of measurement and control technology and instrument adheres to the talent training concept of "emphasizing foundation, strengthening practice and integrating innovation", and builds a practical

teaching system of "basic practice - professional practice - comprehensive practice - improving innovation" step by step. [4] First, by taking advantage of its strong scientific research strength and numerous scientific research projects, the Institute attracts researchers from the Academy of Sciences to participate in practical teaching, and adds courses integrating science and education with production and education, lectures on cutting-edge technologies, and research case projects, etc., to give full play to the advantages of engineering practice ability of industry experts; Secondly, it strengthens the construction of practical curriculum system, increases the proportion of design and comprehensive experimental teaching content, and sets up separate experimental courses in engineering and specialized basic courses. Finally, the comprehensive practice links "Professional Comprehensive Experiment" and "Innovation and Entrepreneurship Practice" with the background of simulating modern mature and complex engineering problems are added, so that students can obtain the basic ability training of engineers.

### **3. Implementation of training programs, theoretical teaching and practical teaching to carry out in-depth reform**

According to the training objectives and graduation requirements of the major, all courses of measurement and control technology and instruments are set up reasonable course objectives, and the teaching content and teaching methods are optimized and adjusted around the course objectives.

#### **3.1. The teaching content and timing of each course are optimized, and the integration and cohesion between courses are strengthened**

In the past, the teaching contents were determined by their respective teachers, and there was a phenomenon of separate management. It was difficult to avoid the phenomenon of crossover and repetition among the teaching contents, and the courses were isolated and loosely connected with each other. In order to solve this problem, from the overall situation of professional development, teachers and researchers were organized to sort out the teaching content of each course, further strengthen the integration of courses, delete the repetitive content between courses, and strengthen the cohesion between courses.

Through the study of the above content, the theoretical curriculum system of measurement and control technology and instrument major has distinct characteristics of integration of science and education, the structure is more reasonable, the logic is stronger, and the content between courses is seamless, which lays a solid foundation for improving the quality of training talents.

#### **3.2. Change the traditional experiment mode, and gradually cultivate students' practical ability and innovation ability**

As for the experiments of conventional courses, in the past, confirmatory experiments were the main experiments, the experimental mode was single, the process was monotonous, and the advanced instruments and equipment could not be brought into full play. Under the new training mode, we make full use of the existing experimental environment and the conditions of the national provincial and ministerial experiments of the Institute, increase the proportion of design and innovative experimental projects in the setting of experimental content, reduce the corresponding confirmatory experiments, improve the experimental level, and improve students' comprehensive application of knowledge and innovation ability. The newly designed practical teaching system is oriented to the cultivation of the ability to solve complex engineering problems, and on the basis of dividing the curriculum experiment/practice teaching link into three levels: basic type, comprehensive practice type and innovative practice type, through the construction of teaching

ideas, means and methods such as "synthesis, openness, collaboration, individuation and combination of virtuality and reality". To achieve the goal of "heavy foundation, strong practice, up to the frontier".

Through scientific research results and engineering practice cases are increasingly integrated into practical classes, students' innovative practical ability is improved. In the past two years, students have participated in the National College Students Intelligent Car Competition, Siemens Cup Intelligent Manufacturing Challenge, Shandong College students Electronic Design Competition, intelligent technology application design Competition, etc., and won more than 40 national and provincial awards.

### **3.3. "Minister of science and education, research and production assistance", do a good job in graduation design and internship**

Under the "2+2" training mode, we make full use of the advantages of the faculty's rich scientific research experience, in order to improve the engineering ability and quality of students, from the perspective of professional theory and engineering application, make full use of existing practical engineering projects, and refine the project and scientific research results into graduation design topics. Special project-based training is provided to students, and the practice and graduation design are carried out in the form of teachers' guidance and students' independent task. We feed our teaching through research, improve students' ability of comprehensive use of knowledge and innovation. After graduation design, students can comprehensively consider cultural, personnel, economic and other factors in a multidisciplinary environment, and can pass a series of links such as literature search and research, program comparison, demonstration and formulation, design/experiment/simulation design and implementation, analysis and summary of results, paper architecture design and writing, presentation and introduction of results, expression and communication of professional problems, etc, enable students to be trained in professional skills and engineering ability, at the same time have the ability of independent and lifelong learning, and achieve the cultivation of students' ability to investigate, analyze and solve complex engineering problems.<sup>[5]</sup>

### **4. With the help of and self-built online teaching resource library, innovative teaching mode of off-site teaching**

In order to better practice the "2+2" talent training model, firmly implement the "student-centered" concept, we actively promote curriculum teaching from "teaching as the center" to "learning as the center", and pay attention to classroom teaching output, and constantly strengthen the construction of information teaching environment and resources.

Professional teachers have investigated and analyzed online teaching modes and effects of first-class universities at home and abroad, and effectively used high-quality network resources such as school online, Wisdom Tree, and MOOC of Chinese universities to explore hybrid teaching modes suitable for remote teaching. At the same time, in view of the shortage and insufficiency of existing online resources, based on the use of original course resources, the team built video resources that are more in line with the school's learning situation. The content of teaching resources covers the theoretical knowledge of books, practical application examples, etc., including multimedia classroom teaching courseware, network learning courseware, thematic learning resource library, network learning resource library, teaching design cases, etc. Teaching resources include word, PPT, audio, video and other forms, each form can be used alone, can also be used together. According to the actual situation of the teaching process, the above resources can be used throughout the various teaching stages such as before, during and after class. At present, 3 courses have completed the

construction of online resources, 2 courses have been launched and put into application, and the online resources of Signal Analysis and Processing, Principle of Automatic Control and other courses have been completed and applied in students. We have achieved a good teaching effect. A number of professional core courses have begun to build AI knowledge maps, and the construction of professional maps is also underway.

## **5. The whole staff will promote the ideological and political construction of the course and educate people**

According to the guidelines of curriculum ideological and political construction of higher education institutions of the Ministry of Education, from the design of curriculum system, we should consider cultivating morality and cultivating people, and implement curriculum ideological and political construction in all kinds of courses. We establish the educational concept of "thinking and politics", give play to the leading role of the Party branch, improve the ideological and political awareness and ability of the curriculum, achieve "ideological and political education in the curriculum, and create a team of ideological and political teachers with strong quality and high ability."<sup>[6]</sup>

1) We give full play to the leading role of the Party branch, establish the curriculum ideological and political studio, carry out the curriculum ideological and political teacher lecturing activities, teachers' enthusiasm to participate in the curriculum ideological and political construction and research is generally enhanced, and the curriculum ideological and political awareness and ability are improved. The team of teachers specializing in measurement and control technology and instruments adopts a variety of ways to improve their literacy and education consciousness, comprehensively improve the teaching level and ability of teachers' curriculum ideological and political teaching, and build a high-quality curriculum ideological and political teaching team.

2) Based on the school-running characteristics and disciplinary advantages of the university, it constantly explores and adjusts in teaching practice, gradually excavates the breakthrough point of ideological and political education, and re-designs the teaching content and methods of the curriculum. The teaching syllabuses of Signal Analysis and Processing, Modern Control Theory, Optoelectronic Testing Technology, Electronic Measurement Technology and Digital Electronic Technology have been supplemented and improved, and the teaching design of the course has been re-carried out to realize that "the course has ideology and politics, and every teacher can educate people". In recent years, the provincial curriculum ideological and political demonstration courses have been approved 2, the course ideological and political teaching research papers have been written 5, and the core courses of measurement and control professional concentration have been approved "moral integration good teaching plan".

## **6. Conclusions**

Under the new training mode of "2+2 academic system", the major of measurement and control technology and instrument and the major of Marine technology focus on the school's idea of "student-oriented, based on application, creating characteristics and serving the local", [5] follow the requirements of conforming to national standards and professional certification standards, promoting first-class professional construction, and adhere to the reform direction of high-quality applied talents training. Based on the needs of relevant technical personnel in the industry, combined with the wishes of students and parents, focusing on ability training and quality education as the core, a series of reforms have been carried out. At the top level, the curriculum system is designed to cultivate the ability to solve complex engineering problems. It form an output-oriented practical teaching system; Practice the teaching mode in line with the "2+2" mode; Promote the

whole course ideological and political construction to achieve ideological and political education. The major of measurement and control technology and instrument utilizes the practical project platform of HAYI Institute and various platforms of college students' scientific and technological innovation competition to promote the all-round development of students' quality and cultivate their comprehensive engineering technology innovation and application ability through scientific research to feed teaching, encouraging learning and promoting teaching through competition.

In the training process, we through the "small class teaching", "personalized training" and other measures, enhance the students' overall grasp of the discipline system, in order to achieve the "foundation, strong practice, up to the frontier" training objectives, to train high-quality new applied new engineering talents. The effective talent training system under the mode of "2+2 learning system" in local colleges and universities is closely related to the overall guidelines of schools, and has certain theoretical significance and application value.

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