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The Construction and Exploration of Practical Teaching Courses for Product Design under the Background of New Engineering

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Abstract: *There is still a certain gap between the training model of Chinese product design talents and the needs of enterprises. In order to better adapt to the needs of social development, it is necessary to adopt a new engineering talent training model. Taking product design as an example, we must first increase the connection between classroom education and the needs of enterprises through the project of courses, and improve the connection between talent training and the needs of enterprises. Secondly, an inter-professional studio should be established to improve the overall quality of students with the function of cross- and joint training of deep chemistry subjects. The new engineering department pays more attention to the practicality, intersectionality and comprehensiveness of the disciplines, so that the talents cultivated are more in line with the needs of social development.*

Keywords: *New engineering; Product design; Talent training; Interdisciplinary*

Research Background

New Engineering Trains Students' Core Abilities

In order to adapt to the new round of technological revolution and industrial transformation in the current world, the Ministry of Education of my country has actively promoted the construction of new engineering disciplines since February 2017 (Zhang, 2017). New engineering is an upgrade and transformation of emerging industries and traditional engineering disciplines. The main research content is summarized as five "New", as shown in Figure 1. The construction of the new engineering department focuses on the intersection and integration of disciplines, pays attention to the development and trend of the industry, and cultivates future-oriented talents according to the future development and trends. The construction of the new engineering department is to carry out the reform of the new engineering talent training model for sustainable competitiveness in accordance with the changes of new technologies, new industries and new social forms (Xu & Ding, 2017).

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Figure 1 Five New developments in the new engineering construction

The new engineering talent training model is setting off a wave of teaching reform. Colleges and universities are thinking about the problems of the current talent training model and exploring the reform of the talent training model under the new situation. Product design is an emerging discipline, which mainly cultivates advanced practical talents who have the ability of innovative design and master computer-aided design technology and can be proficient in application (Xue, 2009). The idea of cultivating talents for product design is in line with the construction requirements of new engineering. With the increasing demand for high-quality product design professionals in enterprises, the task of cultivating innovative product design talents in universities has become more important.

Current Status of Product Design Talent Training

Industrial design in China was born out of art education and started late. Many colleges and universities are also in the stage of educational exploration, and the students trained are out of touch with social needs. Specifically in: First, the teaching of teachers is limited to books, and there is a large gap between the curriculum assignments and the actual needs of the enterprise. The students are designed based on personal hobbies without considering market factors and user needs. Second, when students design works, the practice process is too focused on artistic design, engineering design practice is weakened, and the later production and processing costs and market links are lacking, which does not conform to the actual production situation. In a diversified society, talent training must keep up with social development trends, and university teachers must continue to learn new teaching methods to meet the needs of social development. In terms of talent training, it is necessary to actively reform the inapplicable models, attach importance to practical connotations, and strengthen the relevance of the curriculum to society. Engineering design and art design should be linked to each other in order to cultivate innovative talents more in line with social needs.

Analysis of Research Status at Home and Abroad

Research Status of Foreign Product Design Practice Courses

In the United States, product design majors have fierce competition for employment, so the school attaches

great importance to the combination of production, learning, and research, and special attention is paid to school-enterprise cooperation in curriculum settings to meet the actual needs of enterprises. In terms of product development, the school encourages students to go to companies for internships to gain a deep understanding of the operation of the company's industrial design. The topics of the students' graduation design are basically derived from the practice in the company (Wei, 2018). After studying the product design education of foreign applied colleges and universities, Pan believes that the training of talents in colleges and universities must pay attention to the design of practical teaching links and strengthen the connection with enterprises (Pan & Liu, 2015). American universities will include social project practice in their senior courses. MIT has jointly developed a new CDIO engineering education model with universities and advocates a return to focus on production practices in the education model.

In Finland, some schools attach great importance to open design education and the cultivation of students' innovative consciousness. Aalto University is formed by the merger of three famous Finnish universities, Helsinki University of Technology, Helsinki University of Art and Design, and Helsinki School of Economics. Students at this school can choose courses across colleges and subjects according to their interests and abilities. Students can study in art, business, Cross-border and blended learning in different disciplines such as science and technology, and attach great importance to practice. The school is equipped with the best hardware facilities and strong faculty for each major, such as a complete, open and shared laboratory, which cultivates students' innovative consciousness and practical ability (Chen, 2014).

Foreign art design education models pay more attention to the improvement of students' comprehensive ability and practical operation ability. The author summarizes the education models of different countries, as shown in the following Table 1.

Table 1 Art education models in various countries

Country	Training mode	Main content
Germany	Dual system teaching Model	Education and practical operation are closely integrated, and classroom learning is closely connected with the operation workshop
United States	Multipotency teaching model	You can go to the workshop to learn and practice at any time and arrange practical drill projects
Japan	School-enterprise cooperation teaching model	Participate in practical education activities in the practical operation workshop, and enterprise design talents enter the school to exchange lectures
Australia	New modern apprenticeship system	20% of the time studying in school, 80% of the time studying on the job site

Foreign universities have two common points in talent training:
(1) Design education abroad attaches great importance to cultivating students' practical ability. Students have a lot of hands-on opportunities, and the proportion of practical courses is also large;
(2) The daily teaching will increase the practical projects of the enterprise (Gao, 2017), and it is closely

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connected with the enterprise. The students have mastered the most practical design method and design process in the design process.

Current Status of Domestic Research

The domestic research on practical teaching of product design mainly includes: in terms of practical curriculum construction, Pan and others believe that after researching product design teaching in domestic and foreign universities, my country’s traditional design education emphasizes basic education but lacks practical training, and the gap between the talents cultivated and the needs of enterprises is relatively large (Pan & Liu, 2015). We should reflect on the construction of professional curriculum system, increase the proportion of practical courses, and establish a practical teaching platform. Gao believes that the practice of model making is conducive to improving students' design thinking and innovative thinking, and an open model laboratory should be established to increase students' practice time and enhance their creative ability (Gao, 2017). The practice teaching links in my country's higher engineering education are relatively weak, and cannot adapt well to the requirements of today's social development for talent training. Cultivating outstanding talents with strong practical ability and innovative consciousness has been a hot topic in the reform of product design education. The application-oriented talent training model can better meet the needs of modern society and promote the employment and entrepreneurship of new talents.

In terms of training model, Wang analyzed the current national policies, market demand and talent training plan and believed that the school-enterprise cooperation model is conducive to the training of applied talents for product design in colleges and universities (Wang, 2015). The main measures of this talent training model include the establishment of a school-enterprise cooperation platform, school teachers entering the enterprise, outside experts invited in, and the establishment of a school-enterprise interaction mechanism. Yue and others have conducted research on the "design tutor system" of the product design major. After summarizing and analyzing the operation mechanism and work content of the "design tutor system", they believe that the "design tutor system" is conducive to the personalized development of college students (Yue & Liu, 2019) .

Analysis of Research Status

According to the research of product design practice courses at home and abroad, it can be seen that: First, foreign countries pay great attention to engineering practice, and practice should be integrated with projects and enterprises to keep up with the social trend. Second, there are also various models of talent training in China, and we are also learning from foreign experience in order to cultivate talents that are more in line with economic and social development and better fulfill the tasks of talent training given to universities by the society.

In short, in the teaching reform of product design, we must get rid of the existing traditional teaching mode in our country, focus on cultivating students' practical ability, pay attention to the updating of teaching knowledge content, and better keep pace with social development and meet the needs of enterprise employment.

The Main Content of the Research

Implement Curriculum Projectization and Keep Pace with Industry Development

Practical teaching is one of the most important links in the product design education system. Only by adapting to the development of society and the needs of the industry can it better play its due role (Chen, 2014). In order to improve the degree of connection between students' ability training and corporate job requirements, practical courses are set up as projects, and the sources of projects are actual corporate cases, project topics, and professional competitions, which are directly oriented to engineering and the market.

In the setting of project-based practical courses, the experimental projects are divided into three levels: basic experimental projects, intermediate experimental projects and comprehensive experimental projects. The basic experimental project includes various basic functional operation units, the purpose is to lay a solid foundation for students' practice. Intermediate experimental projects are superimposed applications of basic experimental projects, gradually guiding students to familiarize themselves with the design methods and procedures of the project, so that students can master the basic product design process. The content includes the realization of a single function of the product and simple design projects, such as the design of small products, prototype production, and the realization of certain product functions. The purpose is to allow students to gradually experience and familiarize themselves with the product design process in this process, and prepare for systematic product design.

The comprehensive experiment project is the systematic application of knowledge, which examines the comprehensive ability of students. The project includes a complete product design process, and the experimental project comes from enterprise cases, project topics, and professional competitions. After studying the development trend of product design, the project is updated every year. The design process of each project is to simulate the specific company design process, from the problem to the design product landing process.

In the setting of courses, both basic experiments and intermediate experiments are required professional courses, which are integrated into the attributable courses and form part of the courses. The comprehensive experimental project is a professional elective course, which is open to related majors throughout the school, and the proportion of participants in different majors is set for elective courses.

In the setting of experimental projects, combined with the connotation of new engineering construction, practical content is extracted from three aspects of actual enterprise cases, teacher projects, and professional competitions, so as to reduce the phenomenon of derailment between teaching and society and improve the technical content of the project. In addition, setting up practical projects, simulating the entire process of product design, completing the design through teamwork, cultivating the students' cooperative ability, and achieving the effect of comprehensive education.

Adopt Product Design + X studio Organization Form

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In the form of teaching organization, the studio system is adopted. In addition to the knowledge of basic design modules for freshmen and sophomores, students are guided to set up a design studio in the third year. The members are composed of about 3 students majoring in product design plus 1 or 2 students from other majors. Taking into account the professional knowledge required for project development, the team can combine students of the same grade as mechanical, computer, literature, business administration and other majors as needed. Each studio appoints 1 or 2 instructors to provide technical guidance to the students of the team, and further deepen the function of cross- and joint training in chemistry. In order to better carry out practical courses, starting from the commonality of the majors, first choose the major of mechanical design as a cooperative discipline. The studio team is composed of 3 students majoring in product design and 2 students of mechanical design. Firstly, the model of product + mechanical design is used to study the problems that arise in the process of practice, and to build a preliminary structure for joint training of discipline.

The experimental project comes from a real design case, so the design process is to simulate the real company situation. Students in the design process are based on cooperation. The collision of ideas among students of the same major is the best way to learn and progress. The complementary knowledge of students of different majors is one of the ways to improve the knowledge structure of students. In the process of cooperation, product design students will use the knowledge of product design, ergonomics, market analysis and other aspects to analyze the product positioning, appearance, function, etc., and mechanical design students will use structure, material application, production technology and other knowledge to analyze the product structure, processing technology, production cost, etc. This way of uniting and cooperating to complete the design project, while increasing knowledge, it also invisibly improves the ability of communication, unity and cooperation, and cooperation. But in the traditional teaching process, the cultivation of these abilities is rare.

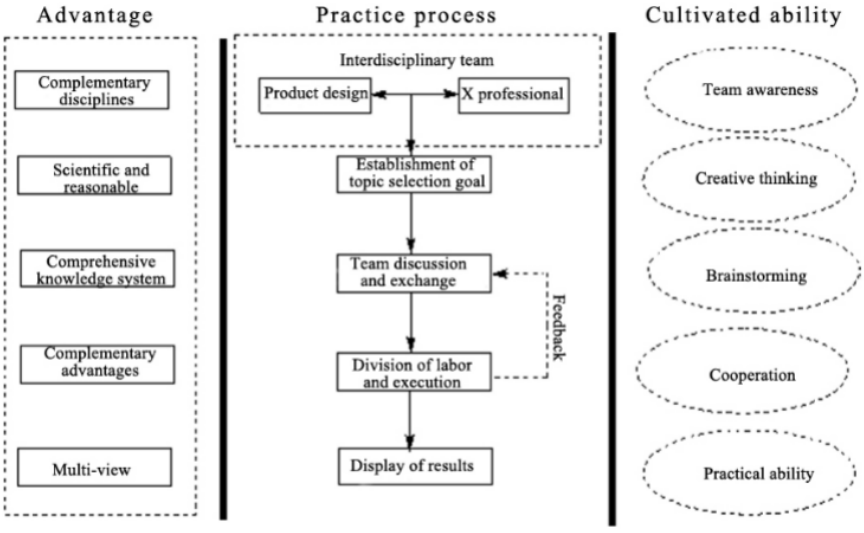

Figure 2 Process and effect of interdisciplinary teamwork

Form an interdisciplinary team with advantages such as complementary disciplines and reasonable processes. In the process of team practice, students have cultivated comprehensive abilities in all aspects, which cannot be obtained in individual practice, as shown in Figure 2.

Use the product + X studio team model to build a framework for discipline joint training. From the overall study of the inter-relationships between various factors in the process of inter-professional practical teaching, we can better grasp the essence and laws of practical curriculum teaching, and build a basic framework for multidisciplinary joint training. Take the product + mechanical design major as an example to discuss the problems that occurred in the practice process, summarize and improve the preliminary structure of multidisciplinary joint training, and provide references for cultivating practical talents with comprehensive knowledge and high professional quality.

The Changes Brought about by New Engineering for the Training of Product Design Professionals

Impact on the Improvement of Students' Innovative Ability

The core of product design education is to cultivate creative talents. The theoretical course is to take students to know this major and to understand the content of product design, while the practical process is to stimulate students' creative inspiration and better understand the connotation of product design. Practice is the best way to cultivate students' creativity. Bring students into a real creative environment, discover and analyze problems in specific creative activities, find ideas for solving problems, design different solutions, and achieve the purpose of product innovation design. The whole process simulates the real design process. Compared with traditional teaching methods, students are more motivated to practice and obtain better teaching effects.

Impact on Student Employment

New engineering focuses on the characteristics of the times in the development of new technologies, and its personnel training is to conform to the current development of the industry and actively deploy talents facing future technologies and industries. Compared with traditional engineering disciplines, new engineering disciplines emphasize the practicability, intersectionality and comprehensiveness of disciplines (Fu, 2017). Therefore, the training of "new engineering" talents is more in line with the needs of social development. Combining with the requirements of new engineering, reform the product design practice courses, realize the docking of course content and professional standards, combine multi-disciplinary cross-training, improve practical innovation ability, and cultivate talents that meet the needs of enterprises.

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