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"Four Dimensions, Four Stages and Five Supports, Integration of Theory and Practice"-Reform and Practice of Professional Curriculum for Industrial Upgrading

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Abstract: The transformation and upgrading of the manufacturing industry make the problem of "shortage of resources and weak teaching" in the professional curriculum of the ceramic materials obvious. This paper discusses the background and thinking of the curriculum reform of inorganic non-metallic materials engineering major, summarizes the reform thinking of "four dimensions, four stages and five supports, integration of theory and practice" and the achievements since its implementation, and discusses the significance of the reform.

Keywords: Inorganic Non-metallic Materials Engineering; Ceramic Materials; Teaching Reform; Practice; Theory

1. Introduction

The Ministry of Education's *Notice on the Implementation of the Spirit of the National Conference on Undergraduate Education of Higher Education at the Time* (Jiao Gao Han [2018] No. 8) wrote the "eliminating useless curriculum and creating practical curriculum" into the document for the first time, emphasizing that China's higher education should strive to build a higher education culture with quality culture as the core. As educators of colleges and universities, they need to be ahead of the changes, actively respond to changes and actively seek for change [1,2], and many scholars have made active exploration on it [3]. As the only provincial university in Chaozhou City, our university has made great achievements in serving local industries. Taking this as a starting point, we can carry out relevant curriculum reform and have a bright future. At present, there are the following problems in the teaching of special professional curriculum for the pillar industry - ceramics - in Chaozhou City.

(1) Fragmentation of theory and practice teaching

In traditional teaching, students often have great cognitive disjoint to the theoretical knowledge and practical operation of ceramic technology, and the teaching tends to be one-sided, which makes it difficult for students to convert theoretical learning into practical skills.

(2) Poor combination of theory and practice

Traditional theoretical curriculum focuses on knowledge recognition and understanding, but students are relatively weak in the use of theoretical knowledge of these processes and the ability to innovate.

(3) Less material innovation content

The teaching of specialty professional curriculum in the ceramic industry of our school has the situation of "shortage of resources and weak teaching", while new materials and processes emerge in the field of ceramic technology [4,5], but it is difficult to update and incorporate new knowledge in time in the traditional teaching mode, which affects the innovative thinking of students.

This paper combines the industrial transformation and upgrading development needs, describes the inorganic non-metallic materials engineering professional ceramics industry-oriented curriculum for the reform program. At the same time of increasing the proportion of the related contents of advanced cutting-edge ceramic cases, it adds the supporting experimental and practical teaching links, constructs the curriculum knowledge system and ability

requirements of theory and practice, constructs and perfects the teaching resource bank, deeply integrates the practice and the theory, and cultivates the applied talents. To achieve the following objectives:

(1) Highlight the advantages of curriculum features and innovate the content of professional knowledge so as to make the talent training method of the specialty more suitable for the needs of the ceramic industry.

(2)Deeply integrate the theoretical teaching and practical teaching of the curriculum to enhance the students' ability to analyze and solve problems, and cultivate their awareness of "craftsmen of the great powers".

(3)Enrich online resources, experimental teaching, internship platform and other teaching resources.

2. Reform Thinking of "Integration of Theory and Practice"

2.1 Integration of Theory and Practice

Comprehensive case study projects are designed to allow students to apply what they have learned through practical projects based on theoretical learning. Change the cultivation mode of knowledge recognition and memorization into the teaching mode of knowledge case and practice, change the situation of single teaching content with theory teaching as the main body, bring ceramic preparation micro-experiment into classroom teaching, and combine the resources of practice base with teaching. For example, in combination with ceramic product design, students are required to put forward the design scheme in the theoretical class and complete the actual production in the practical class. Our team has constructed the curriculum system of "four dimensions, four stages and five supports" and optimized and improved it (Figure 1).

Four dimensions of reforming teaching: knowledge application, ability training, professional thinking and quality promotion. Four-dimensional integration runs through the whole process of teaching and student cultivation.

Four stages: receiving and memorizing, active participation, thinking and questioning, deepens innovation. Four stages in gradual progress.

Five supports: The smooth progress of professional curriculum is inseparable from the teaching team with high specialization and rich experience. It also needs to be supported by an efficient evaluation system, online curriculum resources, excellent cases of demonstration experiments and a counterpart apprenticeship base, so that students' enthusiasm for learning and the efficiency of the classroom can be fully tapped.

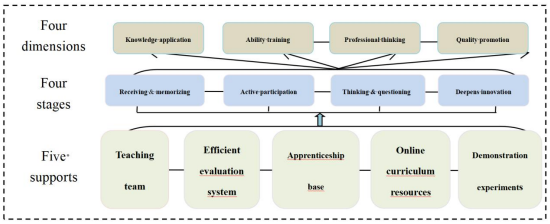

Figure 1. Teaching Reform Method of "Four Dimensions, Four Stages and Five Supports"

Refine and promote the four stages of "receiving and memorizing, active participation, thinking and questioning, deepening innovation", constantly improve the training path of "four dimensions" and enrich and consolidate the "five supports".

2.2 Project-oriented Learning

Introducing industry project-oriented learning (Figure 2), and using the output as an evaluation criterion. Working in small groups, students are engaged in authentic projects involving all aspects of the ceramic process. Through project cooperation, deep integration of process theory and practical experience, basic ability and innovative training, students' ability development is promoted, the basic theoretical knowledge of the curriculum is more solid, professional skills and practical application thinking are improved, and the team cooperation and practical problem solving ability of students are cultivated.

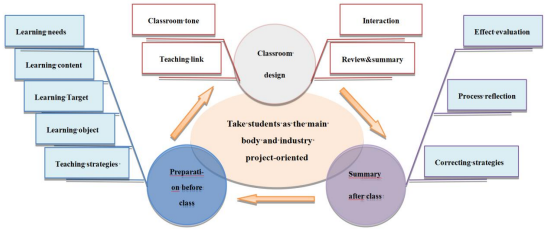

Figure 2. Teaching Reform based on Industry Orientation

2.3 Case Design of Innovation Experiment

Updating the lab cases to incorporate the latest ceramic materials and process practices and encourage students to design and conduct innovative experiments. Bringing production practice into the classroom, students are guided to summarize the practical experience, propose solutions to practical problems, as well as improvement measures through the use of professional knowledge, turning passive acceptance into active participation, thinking, and even innovation. Experimental design and problem solving skills are developed through laboratory cases.

2.4 Industrial Cooperation and Practice

Establishing cooperative relationship with ceramic industry and provide internship opportunities. The Institute of Materials Science and Engineering has a good foundation of cooperation with Chaozhou ceramic enterprises, such as, Guangdong Sitong Co., Ltd. and Chaozhou Three-circle (Group) Co., Ltd. have signed cooperative training agreements with our university. Several batches of students majoring in inorganic non-metallic materials engineering have come to the enterprise for on-site teaching and probation. On-site teaching is carried out through enterprise probation to deepen students' understanding of ceramic process.

3. Reform and Practice of Professional Curriculum for Industrial Upgrading

3.1 Construction of Curriculum Knowledge System of Theory and Practice

Based on the industry demand and applied ability design teaching training goal, around the regional ceramic industry talent requirements, by applying modern pedagogical theories and analyzing the characteristics of the industry, the curriculum materials and the students' learning situation, the top-level design is carried out, and the design is based on the four dimensions of "knowledge application", "ability cultivation", "professional thinking" and "quality enhancement". Change the traditional teaching concept, design the teaching goal according to the industry demand and the student's learning output as the guidance, take the student as the main body idea, promote the study by teaching, promote the thinking by asking, the unity of knowledge and action, to cultivate the students' application-oriented ability of independent cooperation, inquiry learning, practical ability and industry pain point perception. In the reform and practice of teaching, it is divided into four teaching modules: "Introduction or Brief to Ceramics", "Ceramic Technology", "Ceramic Examples" and "Practice" (Figure 3). Each module is relatively independent, but it is an organic teaching system. Focus on the use of professional knowledge to form specialized scientific thinking methods, and learn how to find, analyze and solve problems in the process of scientific research.

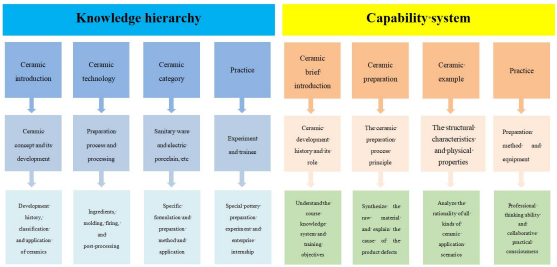

Figure 3. Knowledge System (left) and Capability Requirement System(Right) of *Inorganic Non-metallic Material Technology (ceramic direction) or Ceramic Technology*

3.2 Improvement of Teaching Resource Database

Construction of multimedia teaching resources such as ppt curriculum ware, teaching design, test database, teaching video and other online teaching resources. It explains the theory of ceramic materials more vividly, stimulates students' enthusiasm for learning, films part of the practical sessions and edits and promotes them to facilitate more students' learning.

3.3 Deepening Teaching Reform with Application-oriented Talents Training as the Main Line

Change the cultivation mode of knowledge recognition and memorization into the teaching mode of knowledge case and practice. Taking *Inorganic Non-metallic Material Technology (ceramic direction) or Ceramic Technology* as an example, change the situation of single teaching content with theory teaching as the main body, bring ceramic preparation micro-experiment into classroom teaching, and combine the resources of practice base with teaching. On-site teaching is carried out

through enterprise probation to deepen students' understanding of ceramic process. Bringing production practice into the classroom, students are guided to summarize the practical experience, propose solutions to practical problems, as well as improvement measures through the use of professional knowledge, turning passive acceptance into active participation, thinking, and even innovation. In addition, the teaching content focuses on edifying and cultivating people, and integrates the content related to ideological and education [6] to cultivate students' noble moral sentiment, form correct values, feel the craftsman spirit of the great powers, develop a positive attitude, and increase the classroom teaching capacity. At the same time, the curriculum teaching evaluation is reformed, the study process examination and the student ability evaluation (process evaluation) are introduced into the teaching examination, and the examination method that the practice and the theory are deeply integrated and the performance of the final examination and the ordinary teaching activities are combined is carried out. Curriculum evaluations also allow teachers to reflect on problems with instruction for sustainable improvement.

4. Results of Teaching Reform

Through the mosaic combination of the content of theory and practice experiment, the theory can be closely connected with the practice, the learning efficiency of the students can be improved, and the students can better apply the theory knowledge to the actual ceramic process and improve the practical operation ability. Through project cooperation and practice, students' comprehensive quality will be enhanced in all aspects, including communication ability, team cooperation ability, etc. The openness of the scientific research platform is continuously increased, and the innovative quality and professional skills of students are cultivated. Through collaborative innovation and collaborative education to improve the effectiveness of practical teaching, the number of curriculum apprenticeship units is increasing, the cultivation of applied talents is being strengthened, and students are publishing scientific research and academic papers related to inorganic non-materials or ceramic materials [6-10]. Students participated in more innovative training programs, "challenge cup", "Internet+" and other projects, and obtained good results, winning a number of awards. By participating in innovative projects and experiments, students will develop innovative thinking and entrepreneurship awareness and prepare themselves for their future involvement in the ceramic industry.

5. Conclusions

Through the teaching reform of the integration of theory and practice in ceramic industry-oriented professional curriculum, it can better stimulate the students' interest in learning, help students to deepen the understanding and application of relevant basic theories and knowledge, strengthen students' application-oriented ability and comprehensive quality training, and make them better adapt to the development needs of ceramic industry. The aim of this reform is to cultivate high-quality material (ceramic) professionals who are both theoretical and practical, and to promote the deep integration of curriculum teaching and industrial practice.

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