Reform of Teaching Mode of Non-traditional Machining Course Based on Engineering Practice

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Abstract. In order to adapt to the rapid development of modern processing technology, according to the training goal of applied university, this paper puts forward the reform of teaching mode of Non-traditional Machining based on engineering practice, including revising the syllabus, carefully preparing lessons, online and offline mixed teaching for learning-centered, increasing experimental practice, vigorously improving ideological and political education, promoting teaching and learning by competition and extracurricular innovation, and optimizing the curriculum assessment system. Through the above all-round and three-dimensional course teaching mode reform, students' engineering practice and practical application ability can be improved, and lay a solid foundation for follow-up courses and future engineering and technical work.

Keywords: Non-traditional Machining · Teaching mode · Reform · engineering practice

1 Introduction

Non-traditional Machining is an important part of manufacturing technology, which is different from the traditional machining method that uses mechanical energy and cutting tools to remove outstanding parts of materials, but uses various kinds of energy such as electricity, heat, sound, light, and chemistry and their mixed effects on the parts of the workpiece to be processed, so that the material is deformed, removed, coated, or changed properties in a non-contact way. In recent years, with the rapid development of ultra-precision machining and green manufacturing, Non-traditional Machining technology has become increasingly important.

At present, Non-traditional Machining's teaching goal is to require students to know several new machining methods other than conventional cutting, master the characteristics and scope of application of common Non-traditional Machining methods, and lay a good foundation for professional courses and future work in the industry and its related work.

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2 The Teaching Status of "Non-traditional Machining"

According to the experience of teaching in recent years, the teaching of this course is constrained by a variety of factors:

First, students have not yet completed the study of many professional basic courses, and "Non-traditional Machining" is a multidisciplinary cross and theoretical depth of professional courses, in addition to the students rarely contact with Non-traditional Machining, Non-traditional Machining do not know much, if only "fill in the duck type".

Secondly, there are various methods of Non-traditional Machining, such as electrochemical machining, laser machining, EDM machining, wire-cutting machining, ultrasonic machining, rapid prototyping machining, electron beam ion beam machining, etc. [1], in the case that the teaching hours are reduced again and again, how can the limited class time be used for Non-traditional Machining? In the case of reduced teaching hours, how to effectively complete the teaching content within the limited class time, in the lecture must be clearly prioritized, appropriate details; and various processing methods in processing principles, processing characteristics are different, beginners often feel that the knowledge points are chaotic, difficult to remember and in-depth understanding;

Third, Non-traditional Machining technology involves new materials, new processes, rapid development changes, so the "Non-traditional Machining" course must keep pace with the times and update the content and teaching materials. However, the textbooks of undergraduate colleges and universities are slowly updated, and the contents of the textbooks are often surpassed by the existing technology, so if the teachers do not prepare the lessons sufficiently, they may mislead the students.

Finally, we must start from the goal of training applied undergraduate talents, and comprehensively examine what students have learned in this course, what practical abilities and professional qualities they have acquired, and how to make students feel the greatest sense of achievement. In view of proposing an engineering practice based curriculum, we propose the reform of teaching mode of "Non-traditional Machining" based on engineering practice to promote the teaching effect and teaching quality of this course.

In the background of new engineering, Non-traditional Machining, as an important professional practical course in mechanical engineering, must deepen the reform of course teaching mode with the main task of improving students' engineering practical ability in order to effectively implement the goal of training applied undergraduate students [2].

3 Revision of Syllabus and Condensation of Objectives

The syllabus is the programmatic document of the curriculum and the cornerstone of the professional talents training program. The scientific quality of teaching and learning is determined by the scientific quality of the syllabus, and a scientific top-level design is necessary. Under the background of new engineering construction and professional certification of engineering education, according to the requirements of the current professional talents training program, the prerequisite courses of Non-traditional Machining are

engineering mechanics, engineering drawing, mechanical principles, mechanical design, basic machinery manufacturing technology, etc.; the follow-up courses are Introduction to Moulds, CNC technology, modern enterprise management, etc.

Due to the limited class time, the content of the textbook must be focused on the core content, such as detailed explanation of EDM, wire cutting, electrochemical processing, laser processing, rapid prototyping processing and other widely used, practical chapters, while ultrasonic processing, electron beam processing, ion beam processing and other Non-traditional Machining chapters ask student to self-study.

In order to ensure the reasonableness of the teaching reform of "Non-traditional Machining", many experts from inside and outside the university and relevant industry engineers were consulted to fully discuss the teaching objectives and actively adopt various targeted opinions put forward by experts, so as to effectively play an important role in the training of talents in this course.

4 Conscientious Lesson Preparation and Careful Organization

The lesson plan of this course and the content of each lesson is carefully designed, and the difficulties are well defined. For this course has four main characteristics: theoretical, engineering, application and practical. Students are actively guided to adopt the “4U” learning methods: using the brain, using the mouth (ask more questions), using the pencil and using the hands. We also use various teaching methods, such as project-driven method, case study method, group discussion method, etc. In the content of the lecture to “processing principle - process characteristics - processing equipment - processing parameters” as the main line, layer by layer, to guide students to think independently, to develop their comprehensive application of the knowledge learned and engineering technology skills [3]. For example, in the explanation of laser processing, from the introduction of laser processing principles, to the process characteristics, and then to achieve a certain processing task requires what processing equipment, how to set the processing parameters according to the processing quality requirements. In this way, students are guided to think independently and solve a practical problem in a step-by-step manner, which fully stimulates their enthusiasm and creativity.

5 Adhere to the Learning-Centered Online and Offline Mixed Teaching

The Non-traditional Machining course has a wide range of content, cross-disciplinary knowledge and rapidly changing technology, so it is necessary to use multimedia teaching means to break through time and space constraints, take learning as the center, teacher as the leader and students as the main body, and use online teaching platforms such as University Cloud Space, Dingding Classroom and Super Star Learning Pass to create online resources and dynamic courseware for online and offline mixed teaching. Before class, we release questions through Dingding Classroom and Super Star Learning Pass, and distribute multimedia pre-tutorial teaching resources integrating animation, video, image and sound to introduce teaching contents; in class, we use online and offline

multimedia courseware to focus on key and difficult contents, and actively interact with students; after class, we release online homework, automatically correct homework, count the mastery of each knowledge point, and release reference of related exercises to make students consolidate knowledge points in time. The dynamic courseware makes use of various simulations of advanced processing processes to make students immersive, which can cultivate their imagination and sense of innovation. Timely through the teaching platform, QQ (WeChat) group communication, Super Star Learning Pass, network survey and other forms and ways to understand the voice of students, so that the teaching feedback is comprehensive, real and effective. And timely through the school teaching supervisors to listen to classes, student evaluation, student symposium, course teaching seminars and other ways to actively listen to the views of all parties, and continue to improve the course teaching methods.

As a university teacher, he or she should distinguish right from wrong, take a firm political stance, hold the ideological position in colleges and universities, have a multifaceted knowledge reserve of public, national and party affairs, be attuned to students' needs, actively respond to problems [4]. It is the fundamental mission of teachers to integrate value shaping, knowledge imparting and ability cultivation, teach by example, integrate value guidance into knowledge imparting and ability cultivation, and help students to shape correct worldview, outlook on life and values [5]. Professional skills need long-term theoretical learning and experience accumulation, we must consciously resist all kinds of bad information, and guide students to learn on the ground, to work honestly and to be honest. The introduction of the inventor of electric spark Azarenko, fast-walking wire inventor Zhang Weiliang master, science and technology entrepreneur Liu Zhidong, as well as model workers, skilled craftsmen and other industry stories, to cultivate students' love of work and professional ethical qualities and love of country and love of family, enhance students' national pride, professional confidence and professional self-confidence.

6 Increase Experimental Practice and Combine Theory and Practice

Applied engineering education must adhere to the teaching concept of "the way of engineering, practical is the basis, new is the top" [6], according to the experimental conditions of the college. In this course, four basic experiments are arranged: EDM, WEDM, laser processing and 3D printing. In the experimental teaching process, firstly, the hardware structure and function of machine tools are explained in detail with reference to various machine tools; secondly, the automatic machine tool setting system, processing interface, programming method, and the setting and role of processing parameters are explained; then the hands-on processing session is held, and the operation steps, precautions and safety norms of the machine tools are explained through demonstration by the teacher, and then the actual operation is carried out by students in groups, with on-site supervision by the teacher. Finally, the work will be reviewed and scored on site.

Secondly, comprehensive integrated experimental projects are conducive to improving students' hands-on ability and innovation [7]. Since EDM, EDM wire cutting, laser processing and 3D printing technologies have their own advantages and disadvantages,

in order to complement each other's strengths and weaknesses, during the teaching process, students were organized to set up integrated project interest groups around the requirements of relevant disciplinary competitions, and each group completed a project: for example, integrated use of various methods to machine parts, complete a no-power car, a transmission mechanism or an innovative invention model, etc. In this process, the students discussed with each other, consulted their teachers, worked together, and continuously improved their practical ability and professional quality. Some of the students' works are shown in Fig. 1.

In addition, the teaching experiment project under the school-enterprise cooperation model based on the integration of industry and education is actively explored [8]. Since the school is located in the Songshan Lake Industrial Park, it takes advantage of after-school time to lead students to visit the site of surrounding factories and enterprises to learn, such as large steel plate laser cutting, solar cell sheet laser cutting, precision mold processing, etc. With the addition of these on-site visits for practical teaching sessions, students' theoretical knowledge and hands-on skills have been strengthened, and their sense of learning acquisition and industry awareness have been significantly improved. With the increase of production equipment in the laboratory in the future, more and more practical training projects can be carried out in the laboratory in the future to achieve a higher level of integration of industry and education.

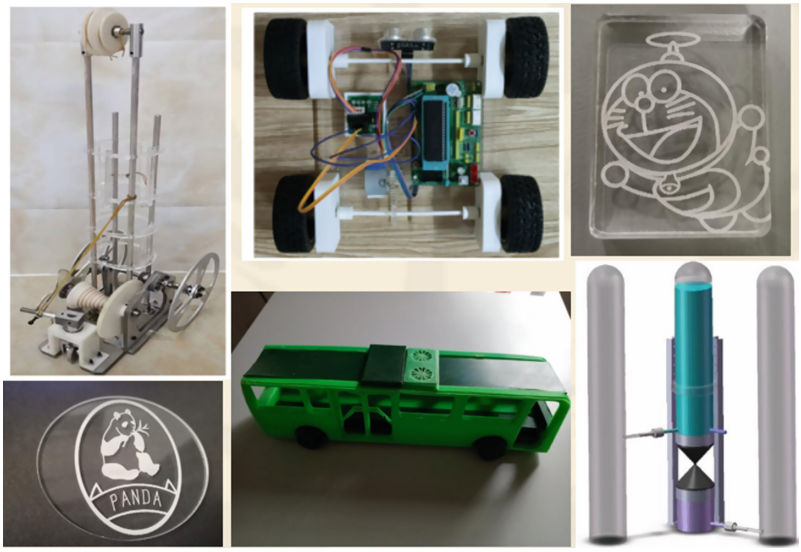

Fig. 1. Some students' works

7 Promote Teaching and Learning Through Competition and Extracurricular Innovation

In recent years, I have guided students to participate in the National Energy Conservation and Emission Reduction Competition, 3D design competition and innovation and entrepreneurship training, guiding them to apply what they have learned, linking theory with practice, and leading them to improve their enthusiasm and initiative in learning and practice. In the past two years, I have guided student teams to win three awards in the National Student Energy Conservation and Emission Reduction Practice and Technology Competition, in addition to guiding three innovation and entrepreneurship training programs for college students, guiding students to publish four scientific research papers, and applying for a number of utility model patents. In these extracurricular competitions and innovative projects, Non-traditional Machining methods such as laser processing and 3D printing play an important role in the process of model making. And the students have greatly improved their professional comprehensive ability in the hands-on practice.

8 Optimize the Course Assessment System

A scientific and reasonable course assessment system is conducive to mobilizing students' learning enthusiasm, cultivating their professional ability and stimulating their learning potential. The traditional exam-oriented education, using the same test paper and uniform standard answers to test students, has many drawbacks. This course combines the new requirements, reformed the use of "regular attendance + regular performance + online assignments + course experiments + course papers" the whole process of assessment form. The usual performance includes pre-course evaluation, in-class evaluation and post-course evaluation. Through the submission of the course paper and offline defense, students independently learn the cutting-edge knowledge of Non-traditional Machining technology and improve their language expression ability, independent learning ability and innovation consciousness.

9 Conclusion

Through the above all-dimensional course teaching mode reform, the engineering practice and practical application ability of students are improved, and the teaching effect and quality are improved. Students can master the comprehensive application ability of various Non-traditional Machining methods, and can combine the traditional machining methods with Non-traditional Machining methods, and select the machining plan from the three aspects of machining quality, productivity and economy, and lay a solid foundation for the subsequent courses and future engineering work.

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