

Exploration on Teaching Reform of < Cad/Cam Technology of Mechanical > Course

Haili Jia^{1*}, Zhe JI², Min LI¹, Xuebin Liu¹, Fan KONG¹

¹School of Mechanical Engineering, Tianjin University of Technology and Education, Tianjin 300222, China

²Qingxian Vocational and Technical Education Center, Qingxian, Hebei 062650, China

36081000@qq.com, 55382140@qq.com, limin@tute.edu.cn, liuxuebin@tute.edu.cn, kongfan@tute.edu.cn

*corresponding author

ABSTRACT. In order to train high skilled and compound mechanical talents, curriculum system structure, curriculum content, teaching means and methods, engineering practice projects and other aspects have been comprehensively reformed. It is aimed at the problems existing in the teaching of “mechanical CAD / CAM technology” such as emphasizing theory and neglecting practice, combining with the characteristics of “mechanical CAD / CAM technology” and taking practical and practical as the principle. The comprehensive teaching mode of “theory system + Project + practice” is constructed to cultivate students' comprehensive analysis ability and engineering application ability. A multi-dimensional evaluation system has been explored.

KEYWORDS: Cad/cam technology, Teaching reform, Task driven, Combination of scientific research

1. Introduction

Mechanical CAD / CAM technology is a practical and comprehensive professional course. It is an advanced technology based on computer technology to assist manual completion of mechanical product design, analysis, optimization and manufacturing. It is an important knowledge that students of mechanical related majors in domestic colleges and secondary schools should master^[1]. “Made in China 2025” puts forward that intelligent manufacturing should be taken as the main direction of deep integration of informatization and industrialization from the national level, while “mechanical CAD / CAM technology” is a course closely combined with manufacturing industry and informatization in mechanical specialty. How to teach and learn the course of mechanical CAD / CAM technology is very important to cultivate talents who adapt to the development of the times in the social background of vigorously developing intelligent manufacturing. However, the current textbooks organized by knowledge system are lack of practical cases of enterprises, the traditional classroom teaching is difficult to mobilize the enthusiasm of students, and the single examination evaluation method is not fair and reasonable^[2], so the training students can no longer meet the needs of high skilled applied talents in the new era.

Domestic scholars have carried out a lot of research and reform around the course of “mechanical CAD / CAM technology”, and achieved certain results. However, how to cultivate students' comprehensive analysis ability and engineering application ability under the background of intelligent manufacturing needs further exploration and reform. The author has been engaged in the teaching of “mechanical CAD / CAM technology” for a long time, as well as the scientific research of related engineering projects. He has also led undergraduate students to participate in engineering practice and scientific research. This paper summarizes the teaching content, teaching methods, practical environment and assessment methods of “mechanical CAD / CAM technology”, which provides reference and reference value for the formation of comprehensive ability of mechanical related majors such as engineering thinking, scientific research literacy and operation skills.

2. Analysis of the Current Situation of Teaching

2.1 Current Situation of Classroom Teaching

“Mechanical CAD / CAM technology” course is based on computer and network technology, including graphic processing technology, modeling technology, engineering analysis and optimization design technology, CNC manufacturing technology, etc., which is a comprehensive and strong interdisciplinary application^[3]. Because the course

involves a wide range of content, logic and derivation is not strong, and in the theoretical teaching mainly classroom teaching, it is difficult to explain it thoroughly and comprehensively. Therefore, many chapters in the current teaching are just guidance points, and cannot be deeply studied and discussed. Students passively receive abstract knowledge in class, which cannot stimulate students' enthusiasm. Although the corresponding experimental class hours are also set in the course, the process of product structure design, optimization analysis and manufacturing is basically completed by using computer software. Due to the inertia of experimental teachers, it is often a confirmatory experiment. Students also stay in the operation of software and virtual simulation, and lack the ability to cultivate students' innovation and self-thinking, which cannot effectively improve students' understanding Practical ability to solve engineering problems [4]. In addition, due to the limitations of experimental conditions, equipment, teachers and so on, we cannot keep pace with the times, follow up in time, and adopt the actual cases closer to the enterprise for teaching, which often fails to meet the needs of enterprises in cultivating students' practical ability, analyzing and solving engineering problems.

2.2 Teaching Resources

At present, in addition to 985, 211 and other key colleges and universities, the number of students and teaching resources in other colleges and universities are obviously out of proportion, especially the experimental equipment and other hardware facilities. For example, four students use one machine tool, and each student can only have 2 hours per day according to the 8-hour system. Although there are a lot of class hours, each student does not reach the required number of class hours on average. The backward hardware seriously restricts the effect of experimental training. The shortage of experimental teachers is also another important factor, such as computer training, one teacher tutors 40 students. For practical courses, students encounter a variety of problems and need time to solve them. Therefore, it is difficult to achieve effective one-to-one guidance. Students often do not think deeply and solve the problems in the experiment and do not train them to solve them Ability. Due to the shortage of experimental teachers, teachers are tired of teaching tasks, and they do not have enough time to develop new experiments and update experimental cases. The experiment of a course is often used for more than 10 years, which is good for professional basic courses such as mechanical drawing and theoretical mechanics, because it changes little with the development of the times. But for "mechanical CAD / CAM technology" such as professional courses, computer technology, network technology, advanced manufacturing technology update development is very fast, and software and hardware upgrades are also very frequent, experimental cases also need to be updated in time. The reality is that the experimental cases remain unchanged for several years and even completely out of touch with the era of intelligent manufacturing, which makes it difficult to mobilize students' enthusiasm and enthusiasm for learning.

3. Reform Objectives

3.1 Promotion of Teaching Concept and Conditions

The key point of the change of teaching concept is to pay more attention to this course and its practicality, so as to enhance its position in professional courses. Pay attention to the relationship between curriculum and the development of the times and technological progress. With the promotion of informatization and intelligence of manufacturing industry, the curriculum also needs to be reformed accordingly. Pay attention to the connection between courses and enterprises, pay attention to the integration of practical cases and teaching, the ultimate purpose of learning is to apply, especially for mechanical engineering courses. Only by renewing the concept can we guide teaching and improve teaching methods and means.

According to the course characteristics of CAD / CAM technology, teaching should be carried out in the multimedia computer room. The computer room should be equipped with multimedia broadcasting system, projector and other equipment. Each student should have a computer, and the corresponding CAD / CAM teaching software should be installed on the computer, such as CATIA, UG, Pro / Engineer, Mastercam, etc. In addition, teachers' synchronous courseware and teaching materials are installed to facilitate students to use and download. In the teaching process, students can clearly and intuitively see the demonstration content of CAI courseware, and at the same time, they can learn, digest and coach in class through practical experience and understanding of theoretical content.

Many colleges and universities are restricted by the cost of machine tools, site, security and other factors, there is a contradiction between the lack of numerical control equipment and the practice of CAD / CAM technology. Although most colleges and universities have established virtual simulation laboratories, the virtual processing environment constructed by software cannot effectively solve the problems existing in the actual processing. In the process of training talents with professional application skills, our college attaches importance to practical teaching, vigorously strengthens the modernization and informatization construction of practical teaching, introduces micro CNC machine tools into the practice class of CAD / CAM, and establishes a micro numerical control laboratory. The micro CNC

machine tool can communicate with the control software on the computer through USB interface, and its control software can read Master CAM's G code generated by the software can obtain the operation instructions and execute the corresponding processing actions. The operation mode fully simulates the large CNC machine tool. Micro CNC machine tool is small in size, low in power and small in motion inertia, so it is not easy to cause personal injury.

3.2 Reform of Teaching Content

At present, many textbooks on the market are similar, and the theoretical content is too heavy. Therefore, the contents of computer graphics and computer database should be appropriately deleted. The reason is that it is very difficult for students without computer foundation to understand these contents, but the deletion does not affect students' practical ability. Therefore, the teaching content should be combined with the selection of some CAD / CAM software books. In addition, the teaching content should keep pace with the times and choose popular software to explain. In this way, students can be clear about the purpose of learning in the process of learning, so as to achieve targeted.

In order to carry out the integrated curriculum reform of CAD / CAM course, it is necessary to compile the teaching materials with the idea of working process oriented. All tasks are real typical cases, and the expression form of illustrated text is used, which is clear and intuitive, easy to start, and can stimulate students' interest in learning. And according to the application characteristics of CAD / CAM course and the general process of engineering design, the task is from simple to deep, step by step.

3.3 Innovation of Teaching Methods

The traditional classroom teaching based on theoretical system is changed into a comprehensive teaching mode of "theoretical system + Project + practice" driven by task. The task refers to the competition, curriculum design and graduation design topics related to the course, as well as the actual cases of enterprise engineering or related scientific research projects. In the traditional teaching mode, it creates opportunities for students to go out of the classroom, enter the project group, and integrate with other curriculum groups. The specific forms are summarized as follows:

(1)Task driven in the form of curriculum design or graduation project. Do the works related to the course, and experience the theoretical essence of the course in the process of forming my own works. For example, take the secondary reducer completed in the course of mechanical design as an example, let students use 3D CAD software to complete modeling, assembly and motion simulation. On this basis, ANSYS is used to analyze the stress and deformation of transmission shaft and transmission gear. Finally, the more complex shaft or gear is selected to complete the CAPP process arrangement and the automatic generation of cam NC program. Combined with the course design of process fixture design, complete the design and assembly of parts and fixtures and automatic two-dimensional engineering drawings, complete the stress analysis of fixture positioning and clamping scheme, complete the preparation of process documents by applying CAXA or open-ended CAPP, and finally carry out the NC programming and machining simulation process according to the process parameters.

(2)Outward bound training combined with scientific research. Taking the 863 project "research and development of precision reducer for industrial robot" of 863 project of Institute of new precision transmission of Institute of mechanical engineering and applied to 2K-V precision reducer prototype supported by NSFC OF SHENYANG Xinsong robot company as an example, the model design, assembly and motion simulation are completed by using 3D CAD software (UG, CATIA, Pro / E, etc.). The 2K-V precision reducer is shown in Fig. 1, Fig. 2 and Fig. 3. CAE software such as ANSYS is used to complete the model design, assembly and motion simulation The stress-strain analysis of cycloid gear and pin gear with flexible body is carried out by Adams or RecurDyn. Taking cycloid gear or involute planetary gear as an example, the automatic generation of machining program is completed. The above contents have certain difficulty and large amount of tasks. It is necessary to divide students into groups and exercise certain self-study ability and independent problem-solving ability. At present, this method is implemented in combination with graduation project design. The total task is divided into modules with equal workload, and students are required to discuss and cooperate with each other. Through the graduation project in recent five years, students' ability has been greatly improved.

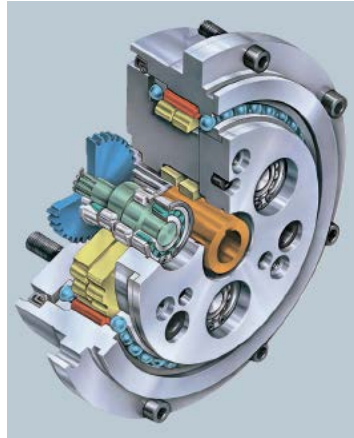


Fig.1 3d Assembly Drawing of 2k-V Precision Reducer



Fig.2 Prototype Object

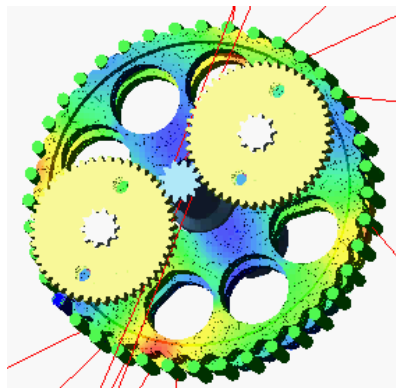


Fig.3 Stress Analysis Diagram

(3) Create more opportunities for school enterprise cooperation. Because the market is the basis of product design, without market demand, there will be no development of these emerging technologies, and there will be no product design. Understanding market dynamics is one of the responsibilities of CAD / CAM Teaching, and it is also a necessary condition for students to adapt to the needs of enterprises. The mastery of CAD / CAM technology can not only stay in the level of skilled operation of application software, but also be combined with actual production, so as to be more practical and improve students' innovation ability. These have played an important role in the development of teaching, the employment of students and the development of enterprises, and greatly improved the quality of teaching practice. At present, the College of mechanical engineering cooperates with Qingdao Haier and Tianjin automobile mould Co., Ltd. the graduation design students enter the enterprise and carry out the practical cases of the enterprise. The guidance is jointly undertaken by the enterprise tutor and the school tutor. After the Graduation Training of the enterprise, the students obtain better practical problem-solving ability, and the initiative and interest of the graduation project are greatly increased.

(4)Use network platform to promote communication. With the development of network technology, students are more interested in network communication. In addition, due to the limited classroom time, students' problems or ideas cannot be found and effectively communicated. Therefore, teachers should give full play to the advantages of network platform, establish students' curriculum group, timely understand and answer problems in learning, provide high-quality network resources, and guide students to learn independently after class.

4. Conclusion

In conclusion, the ability of engineering practice and the ability to analyze and solve problems are the basic requirements for high-quality skilled talents. Through the task driven “theory system + Project + practice” comprehensive teaching mode reform, students' ability to solve engineering problems in practice has been greatly improved. However, there are still many deficiencies in the teaching of mechanical CAD / CAM technology course, and further reform and practice are still needed to improve the training quality of mechanical professionals.

Acknowledgement

This paper is supported by the first batch of industry university cooperation collaborative education projects of the Department of higher education of the Ministry of education in 2018(NO. 201801086047).

References

- [1] Zhang Lihui, Wen Donghui, Wang Hui, et al. Teaching reform of mechanical CAD / CAM flipped course based on micro lecture [J], education and teaching forum, Vol.4, No. 16, pp. 186-187, 2020.
- [2] Zhang Wenjian, Ji Hong. School based reconstruction of Higher Vocational Curriculum Based on enterprise demand [J], Southern agricultural machinery, No. 5, pp. 159-160, 2020.
- [3] Miao Yanping, Cai Donggen. Exploration and practice of curriculum reform and textbook construction of CAD / CAM technology in Higher Vocational Education [J], vocational education forum, No. 29, pp. 64-66, 2017.
- [4] Yin Xiaoli. Reform and practice of practical teaching system of “virtual reality combination” of CAD / CAM course [J], science and technology style, No. 4, pp. 39-40, 2017.