

Study and Discussion on Integrated Teaching Reform of Cad/Cam/Cnc Course

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Abstract: In order to cultivate CAD/CAM/CNC technical personnel urgently needed in the modern equipment manufacturing technology, and aiming at the problems existing in current CAD/CAM/CNC course teaching, the basic ideas of the integrated teaching of CAD/CAM/CNC course was established, the implementation steps of the integrated teaching of CAD/CAM/CNC course was proposed, the “double-qualified” teacher team was established and the scientific and reasonable assessment method was presented in the paper. The results can provide theoretical guidance and methods reference for the integrated teaching reform and implementation of CAD/CAM/CNC course in other colleges and universities.

1. Introduction

With the development of computer technology and modern equipment manufacturing technology, more and more industries start to use CAD/CAM/CNC technology to shorten the product development cycle, reduce costs and improve market competitiveness^[1]. The development of digital manufacturing and intelligent manufacturing have produced a huge impact on the teaching methods of traditional numerical control processing technology, which mainly focus on manual programming and emphasize on increasing the investment of hardware equipment. At the same time, upgrading and rebuilding of the industry, upgrading of the product and the use of new technologies and processes have increased the demand for high-end numerical control skilled personnel. Therefore, to satisfy the social demand for numerical control technical personnel and numerical control technology development objectives, it has become a pressing matter of the moment to cultivate the numerical control skilled talents with high quality, innovative ability and practical ability that meet the needs of social and economic development. Aiming at the current situation, it is necessary to integrate the idea and connotation of CAD and CAM technology into the teaching and practice of numerical control processing technology to provide the theoretical guidance and method reference for the teaching reform and practice of the CAD/CAM/CNC course^[2].

2. Teaching Current Situation of Cad/Cam/Cnc Course

The integration of computer technology and modern equipment manufacturing technology, as well as the rapid development of numerical control technology, the demand for numerical control technical personnel of enterprises have been increased. In order to adapt to the development of social economy and meet the demand for numerical control technical talents of enterprises, The CAD/CAM courses such as AutoCAD, SolidWorks, Pro/E, UG and so on have been set up in mechanical majors for the application-oriented universities, and the corresponding CAD/CAM laboratories are established to practice expediently for students. For the CNC technology, numerical control processing technology and programming, numerical control simulation operation training and so on have been set up. At the same time, the numerical control training base is established to facilitate students to carry out actual combat drills and make students feel like that they are in the

manufacturing process of enterprises. However, there are still many problems in the specific teaching process, which are embodied in the following two aspects.

2.1 Curriculum Independence Setting

The involved contents of CAD/CAM/CNC are setting curriculums independently, such as computer aided drawing (AutoCAD), three-dimensional modeling design (Pro/E), automatic programming (Pro/E), numerical control processing and programming, numerical control simulation training and so on, which do not form organic whole^[3]. In the specific teaching practice process of each course, there is a lack of an effective main line, which can effectively connect the knowledge and skill requirements of relevant courses. In addition, the teaching practice has not been carried out in accordance with the requirements of CAD/CAM/CNC technology integration in the current manufacturing industry, which causes students' knowledge and skills to lack of system and consistency, and further leads to the lack of improvement of students' comprehensive application ability. Moreover, the theoretical courses and practical courses are undertaken by different teachers for some colleges and universities in specific teaching process, which make the theory and practice teaching disjoint because the key points of teaching hold inconsistently. As a result, it is not good for students to master the knowledge and skills.

2.2 Lack of Coherence and Systematicness for Teaching Content

At present, the diversity of CAD/CAM software and CNC machine tool operating system make them more optional, which may lead to a lack of coherence and systematicness in teaching content. The learning process of CAD/CAM software is mainly carried out in the following sequences. The computer aided drawing software AutoCAD is learned in the second semester of freshman year, the 3D modelling software such as SolidWorks, Pro/E, UG and so on is learned in the first semester of sophomore year, while the CAM software such as Pro/E NC, UG NC, Master CAM and so on is learned in the second semester of sophomore year. This make the learned software appear the phenomenon of miscellaneous and much, much but not fine. Namely, the learned CAD/CAM software lacks coherence and systematicness. In addition, the post-processing of CAM software depends on specific CNC machine tools and systems, and there are a wide variety of CNC machine tools operating systems such as Fanuc, Siemens, Mitsubishi and so on. When teachers in different colleges and universities teach CNC programming, the students master different CNC operating systems due to different teaching materials or teaching focuses, even different from these in the training base, which cause it difficult for students to better master CNC operating system software.

3. Construction of Integrated Teaching Ideas of Cad/Cam/Cnc Course

3.1 Teaching Ideas

The goal of the integrated teaching of CAD/CAM/CNC course is to train high-skilled application-oriented talents who are proficient in using a certain CAD/CAM software (such as Pro/E) to design parts, automatically program and operate CNC machine tools to process parts. According to the training objectives of the course, and combined with the existing software and hardware conditions of the university, the basic ideas of the integrated teaching of CAD/CAM/CNC course is as follows: part drawing analysis, two-dimensional graphics drawing, three-dimensional modeling design, numerical control processing technology analysis, automatic programming, simulation processing and entity processing.

3.2 Teaching Design

According to the teaching ideas, the integrated teaching design of CAD/CAM/CNC course is carried out. Taking the part drawing analysis, design, programming and entity processing as a teaching design main line, the teaching contents are organized around all relevant knowledge and skills involved in this main line, which make students have a clear understanding of the whole process of product production. The CAD/CAM/CNC course is divided into CAD module, CAM module and CNC module according to the knowledge and skills involved it. Then, the teaching

works are organized in accordance with three modules, which lead to achieve the purpose of systematization of teaching content, coherence of knowledge and skills, and integration of students' abilities. The specific teaching contents of three modules are as follows.

(1) CAD module: This part is the foundation, mainly learns AutoCAD drawing methods including basic graphic drawing, graphic editing, dimension marking, assembly drawing, etc.; It also learns Pro/E two-dimensional sketch drawing and editing, solid feature modeling method, assembly drawing creation, explosion drawing creation, engineering drawing creation, etc., and the proficiency degree in using AutoCAD and Pro/E software of students is improved through practical training.

(2) CAM module: This part is based on established a three-dimensional solid of typical part (reference model) and blank (workpiece), mainly includes analysis numerical control processing technology of part, selection processing method such as turning, milling, turning and milling synthesis, wire cutting, etc., planning processing procedure, manufacturing setup including machine tool setup, clamp setup, tool setup, processing zero and return tool plane setup, etc., selection processing modes including NC sequence setup, processing parameter setup, etc., generation cutter location (CL) data files and removing material simulation processing. At last, the G codes recognized by the machine tool are generated by post-processing combined with specific CNC machine tool and system.

(3) CNC module: This part requires to be familiar with CNC turning, CNC milling, machining center and wire cutting machine structure and operation interface, master the basic operation and working principle of these machine tools, deftly write processing programs of general parts, be familiar with inputting and debugging programs, clamping parts, selecting and clamping tools, and numerical control processing of parts.

4. Implementation Steps for Integrated Teaching of Cad/Cam/Cnc Course

In accordance with the teaching objectives and characteristics, the teaching contents are organized to implement. And the Pro/E is used as CAD/CAM teaching software, which can ensure the continuity and systematicness of the learned software^[4]. The specific teaching implementation steps are as follows:

(1) Determination teaching task of project: It is taking the typical parts such as axis parts, disk parts, complex curved surface parts as specific project teaching tasks, and the specific requirements of project teaching tasks are proposed based on the characteristic of part.

(2) CAD module: According to the specific requirements of the project teaching tasks, the two-dimensional sketch drawing, three-dimensional feature modeling, assembly drawing creation, explosion drawing creation, engineering drawing creation, etc. of Pro/E are learned. And the three-dimensional modeling design and editing modification of simple structural parts and medium complex parts are conducted expertly by using Pro/E.

(3) CAM module: According to the created three-dimensional entity of parts, the numerical control processing technology is analyzed, the processing methods are selected, and the processing procedures are planned. Then, the automatic programming of typical parts is carried out using Pro/E. The detailed process and related knowledge including machine tool and tool selection, processing zero creation, retraction tool plane setup, NC sequence setup, processing parameters setup, CL data files production and material removal simulation processing of the automatic programming are learned. And the G codes can be recognized by the machine tool, which are generated by post-processing combined with specific CNC machine tool and system.

(4) CNC module: According to characteristic of part, the CNC machine tool is correctly chosen, the structure and operation interface of the CNC machine tool are known, and the basic operation and working principle of the CNC machine tool are mastered. Then, the part is correctly clamped, and the tool is chosen and installed. After that, the programs are inputted and checked, the simulation processing of tool path is conducted, the processing zero point and machine tool coordinate zero point are checked, and whether the phenomenon of interference or overcutting at the tool breakthrough point and tool exit point happened or not is checked^[5]. Finally, the entity

numerical control processing of part is carried out.

5. Establishment of “Double-Qualify” Teacher Team with Strong Theory and Rich Practice

The integrated teaching process can be finished with requiring teamwork and mutual assistance because of the CAD/CAM/CNC course involved multi-disciplinary, multi-field. Therefore, the establishment of a high-quality, rational structure, “double-qualified” teacher team with strong professional theoretical knowledge and rich practical experience is the key to the integrated teaching of CAD/CAM/CNC, but it is also the premise of guarantee the integrated teaching quality of CAD/CAM/CNC. The integrated teaching of CAD/CAM/CNC course has higher requirements on teachers' quality, which are reflected in not only strong professional theoretical knowledge and rich practical experience, but also the ability of analysis and solution problems. Otherwise, it is difficult to introduce teaching schemes, organize teaching processes, and answer questions freely^[6]. In terms of teacher structure, the CAD/CAM/CNC integrated teaching team should be composed of the old, the middle and the young with a reasonable number of 3-5, which can give full play to the advantages of each member of the teacher team. In addition, the technical personnel of enterprise production line can also be invited to join the teaching team, who can bring in the case of enterprise and achieve the consistent of the teaching process and the enterprise working process. Thus, the initiative and enthusiasm of learning for students are stimulated, and finally, the purpose of improvement teaching quality is achieved.

6. Presentation of Scientific and Reasonable Assessment Method

The CAD/CAM/CNC course contains two parts: theory and practice. The final assessment method cannot objectively and comprehensively reflect the knowledge and skills level of students. Thus, the comprehensive evaluation of students is carried out by combining the process assessment with the final assessment^[7]. Process assessment mainly examines the ability of mastering knowledge, application, practice and operation, and proficiency degree in the whole teaching process. The final scores of students are composed of the final assessment scores and the process assessment scores accounting for 40% and 60% respectively^[8]. The process assessment scores contain attendance 5%, class performance 10%, computer operation 30%, comprehensive practice 30% and after-class practice 25%. This assessment method runs through the whole teaching process with the purpose of fully mobilizing the initiative and enthusiasm of learning for students, cultivating the ability of combining theory with practice, analysis and solution problems, as well as the ability of sorting out and synthesizing for knowledge, which can be avoided surprise review before the test and dealing with the phenomenon of the test.

7. Conclusion

Taking from part drawing analysis, three-dimensional modelling design, programming to processing as a main line of integrated teaching of CAD/CAM/CNC course, taking CAD, CAM, CNC three parts as a teaching contents, and taking typical project tasks as carrier, the training of the theoretical knowledge and practical skills of CAD/CAM/CNC is integrated into the teaching process. The teacher is teaching while the students are learning and practicing, which make the teaching, learning, practicing integrate really. It not only achieves the purpose of teaching theoretical knowledge, but also cultivates practical skills for the students. As a result, the synthetical abilities of combining theory with practice, analysis and solution problems are improved.

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