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Reasearch on the Practice of Teaching Reform of Professional Curriculum Design Based on the Cultivation of Digital Design and Manufacturing Capability

Jinzheng Zhang[1], Mingxin Yuan[1], Qunbiao Wu[1] & Lijia Tao[1]

[1] School of Mechatronic and Power Engineering, Suzhou Institute of Technology, Jiangsu University of Science and Technology

Correspondence: Jinzheng Zhang, School of Mechatronic and Power Engineering, Suzhou Institute of Technology, Jiangsu University of Science and Technology.

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Abstract

This paper points out the importance of digital design and manufacturing ability training in the teaching reform of professional curriculum designs for mechanical majors in colleges and universities, and proposes a practical approach to the teaching reform of professional curriculum designs teaching reform based on digital design and manufacturing capability training. Taking the teaching reform practice of professional curriculum designs courses in Zhangjiagang Campus of Jiangsu University of Science and Technology as an example, it is obivious that the training method of digital design and manufacturing comprehensive ability can effectively improve the teaching quality and effect.

Keywords: digital design and manufacturing, professional curriculum designs, reform in education

1. Introduction

Professional curriculum designs is a major course in mechanical design, manufacturing and automation in the School of Electromechanical and Power Engineering of our school. It is also an important practice teaching link in the practice teaching system of the talent training program, which serves as a link between the past and the future, as shown in Figure 1. After completing courses such as engineering graphics, Mechanisms and Machine Theory, mechanical design, interchangeability and technical measurement, mechanical manufacturing technology foundation and necessary practical links, Professional curriculum designs are carried out. In this course, students are required to comprehensively apply the basic professional knowledge they have learned and conduct comprehensive training to cultivate their ability to analyze and solve problems independently. Professional curriculum designs enable students to have the abilities of mechanical system scheme design, mechanical transmission scheme design, parts manufacturing process design, standard parts selection and non-standard parts design, check calculation, etc., and at the same time cultivates students' abilities of theoretical analysis, graphic realization and application of national standards and norms (Lyu, Z.S., Mi, H.L., Han, G.Q. & Wang, C., 2021). Traditionally, the Professional curriculum designs course focuses on the application of the relevant professional knowledge of the prerequisite courses, but there is less training in improving the digital design and manufacturing ability, insufficient training in innovation ability and 3D-CAD/CAE /CAM application skills, and insufficient design reliability. Therefore, previous courses of this kind have not achieved satisfactory teaching results (Qian, Z.P., Ma, R., Zhao, S.Y. & Gu, Y.F., 2019).

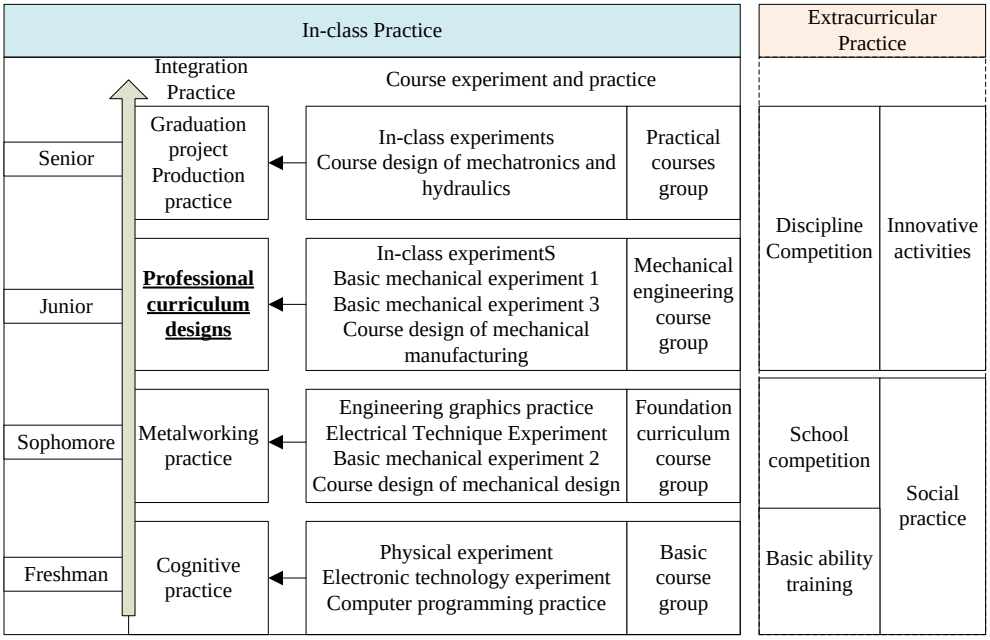

Figure1. Practical teaching system

2. Practice and Validation of the Teaching Reform of Professional Curriculum Designs Based on the Cultivation of Digital Design and Manufacturing Capability

Starting from 2020, the mechanical design, manufacturing and automation major of our college has carried out the practice and exploration of the teaching reform method of Professional curriculum designs based on the cultivation of digital design and manufacturing ability. Professional curriculum designs last for three weeks, but the implementation of specific design tasks basically covers one semester. The design tasks are mainly divided into the following five stages:

Stage 1: Professional students are divided into groups of five, the group leader is determined and the division of labor within the group is defined. Complete the topic selection according to the assigned curriculum design content (for example, in 2021, the topic was selected from Jiangsu College Students' Mechanical Innovation Design Competition: Bionic Machinery);

Stage 2: access to relevant domestic and foreign literature, understand the types, structure and working principles of products related to curriculum design, and clarify the background of topic selection, the purpose and significance of the research, the current research status at home and abroad, research contents and research methods. Define the design objectives and determine the overall design scheme;

Stage 3: Structural design and analysis, detailing the specific structural design process, theoretical calculation process, strength check analysis (finite element analysis, etc.) of important functional components (such as working device, transmission device, driving device, transmission device, etc.), and determining the design parameters. The selection process of standard parts, calculation and selection process of power, etc. should also be explained. If the electronic control part is involved, the software, hardware and program realization process should be explained in detail. Based on the above design content, 3D-CAD software is used to complete the product 3D modeling.

Stage 4: simulation analysis and test analysis, mainly including the establishment of a virtual prototype based on CAE/CAM software, virtual assembly, motion simulation analysis, dynamics analysis, machining simulation, etc. If the electronic control part is involved, experimental test and analysis are required;

Stage 5: Drawing the general assembly drawing and parts drawing with 2D-CAD software. Based on the previous theoretical analysis and calculation and the conclusion of the 3D-CAD/CAE/CAM simulation analysis, the design specification is summarized and the design reply is made.

The following figure 2 illustrates a devil-fish-like submarine detection robot independently designed and trial-produced by the student team with the help of 3D-CAD/CAE/CAM application skills according to the knowledge of mechanical design, bionics and fluid mechanics. The bionic robot can realize underwater autonomous swimming, remote swimming and underwater monitoring.

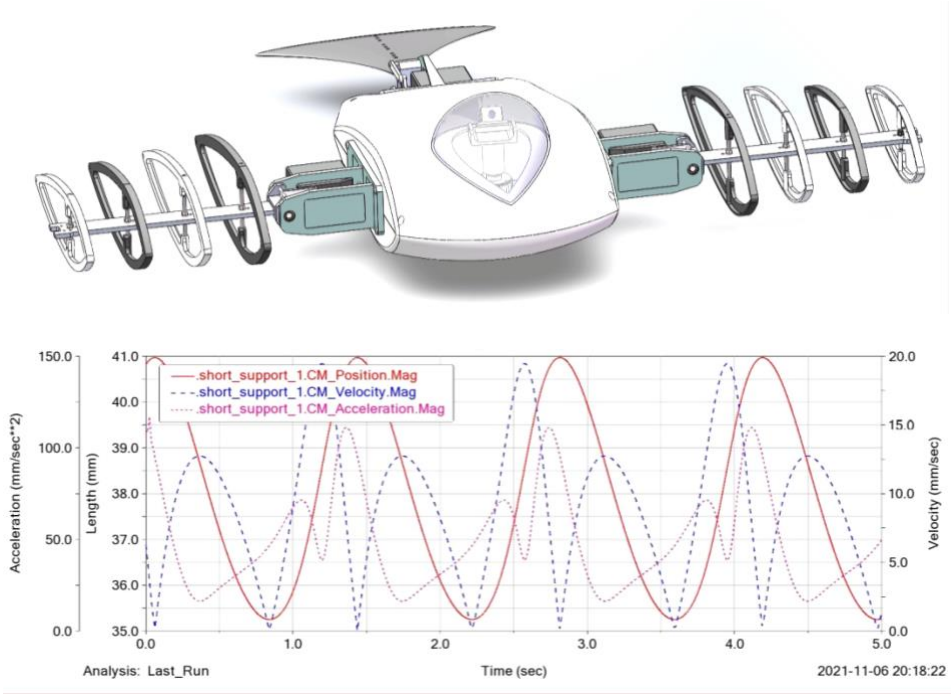

Figure 2. Bionic machine design case independently completed by student team

Teaching practice for several semesters indicates that the practice method of Professional curriculum designs teaching reform based on the cultivation of digital design and manufacturing ability has achieved remarkable results in teaching, which are mainly reflected in the following two aspects:

① Compared with the traditional teaching method, the training method of digital design and manufacturing ability based on Professional curriculum designs improves the practical learning effect obviously. Students have a strong interest in exploring new knowledge, their innovative ability is trained, and their application skills of 3D-CAD/CAE /CAM are significantly improved. Most students can complete the design task well with the cooperation of the team. At the same time, the average score of this practical course is increasing year by year, with the overall excellent and good rate increasing from 37.1% to 52.2%.

② Professional curriculum designs teaching reform practice methods based on the cultivation of digital design and manufacturing ability can obviously improve the teaching effect of comprehensive practice course. Based on the students' solid mastery of engineering graphics and 2D-CAD skills, the students' feedback has obviously enhanced their team cooperation ability, non-standard mechanical design ability, mechanical product optimization design ability and application skills of 3D-CAD/CAE/CAM software, which is widely praised by students.

3. Conclusion

With the background of "internet plus" and new engineering, it is imperative to reform the teaching of practical courses represented by Professional curriculum designs. In this paper, the teaching reform practice method of Professional curriculum designs based on the cultivation of digital design and manufacturing ability is put forward, and the teaching practice is carried out. While the teaching reform has achieved the expected goal, no concrete work has been carried out in the information transformation of teaching tools, teaching methods and teaching equipment. It is necessary to take the "internet plus Digital Design and Manufacturing" thinking as the guide to further reform the teaching system of Professional curriculum designs, carry out the reform and course construction of Professional curriculum designs in an orderly manner, and constantly update and enrich the practical teaching system with the aim of serving the local machinery manufacturing industry and cultivating applied engineering and technical talents, so that students can apply what they have learned, which can promote their learning and learn from each other.

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