

New Ideas for Teaching Reform of “Mechanical Design” in Applied Undergraduate Universities under the Background of “Made in China 2025”

Yu Dongling, Liu Guiling, Liao Dahai, Wu Nanxing

School of Mechanical and Electronic Engineering, Jingdezhen Ceramic University, Jingdezhen 333403, Jiangxi, China

Abstract: “Mechanical Design” is a compulsory basic course for mechanical majors in the undergraduate period. Students learn the course, combined with the comprehensive application of the knowledge learned in mechanical courses such as mechanical principles, and have the initial mechanical design and manufacturing ability. With the specialization, intelligence and modularization of equipment manufacturing, the shortcomings and shortcomings of traditional teaching ideas are increasingly apparent.

Keywords: mechanical design, teaching reform, teaching measures

1. INTRODUCTION

Mechanical design is based on the use of the requirements of the working principle of machinery, structure, movement, force and energy transfer mode, the material and size of parts, lubrication methods and other conception, analysis and calculation, and will be translated into a concrete description of the work process as a basis for manufacturing. “Mechanical Design” is one of the main professional compulsory basic courses at the undergraduate level of mechanical majors. The main task of the course is to train students to master the design principles, methods and general laws of mechanical design of general mechanical parts, with the ability to design general simple machinery; with the ability to apply standards, specifications, manuals, diagrams and other technical materials, and to master the experimental methods of typical mechanical parts. With the rise of artificial intelligence and Made in China, the shortcomings and problems of the traditional teaching ideas and modes of the course have gradually emerged, and the development of teaching reform has been slow, not keeping pace with the development of Made in China in the new era, and still staying in the traditional mechanical design teaching mode of thinking.

2. PROBLEM ANALYSIS AND NEW IDEAS FOR EDUCATIONAL REFORM

With the continuous improvement of China’s industrial system, the selection criteria for professionals in the manufacturing industry are also changing, making it necessary for colleges and universities to respond to these changes and constantly adjust their teaching ideas and specific teaching measures so that students can have enough professional knowledge to adapt to the needs of enterprises when they graduate. So far, there are still some problems in teaching ideas and teaching measures, such as: the slow development of the course, can not keep pace with the times; students lack of knowledge and application of standard components; ignore the importance of sensors, electronic control systems, ergonomics, design and mechanical design courses and the effective connection; in the mechanical design process of the layout and installation of lines and pipes are not In the process of mechanical design, the layout and installation of lines and pipes are not fully considered; the concept of precision design is lacking, etc.

In response to the above-mentioned problems in the Mechanical Design course, new teaching ideas and specific teaching measures are proposed, i.e., new innovative teaching reform ideas for this course’s student training concept as well as training methods and lecture arrangements, as follows in Fig. 1.

(I) Update the content of the “Mechanical Design” course materials, add electronic control, ergonomics, sensors and other related expertise in the context of manufacturing in China and mechanical design is more articulated.

(II) The relevant class adjustments, it is recommended to increase ah 10 or more research hours, the structure of standard components, working principles of research and add the corresponding research assignments part.

(III) In addition to strengthening the study of the course, teachers should train students to learn related professional knowledge outside the professional curriculum.

(IV) Closely integrated with the “Mechanical Design Course Design”, in the initial stage of the course, that is, to arrange course design tasks to students, clear task objectives.

According to the course process, every time a stage of knowledge is taught, that is, to inspire the students in the course design needs to be completed to achieve the function of the mechanical design, to achieve a close combination of theory and practice, to achieve a seamless connection between the professional knowledge of learning and application capabilities, to improve the learning effect.

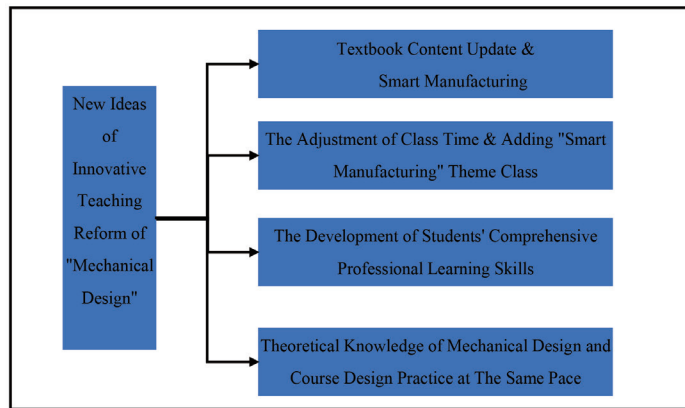


Fig.1 The new ideas of innovative teaching reform of “Mechanical Design”

3.SPECIFIC TEACHING REFORM MEASURES

With the continuous improvement of China’s industrial system, the selection criteria for professionals in the manufacturing industry are also changing, making it necessary for colleges and universities to respond to these changes and constantly adjust their teaching ideas and specific teaching measures so that students can have enough professional knowledge to adapt to the needs of enterprises when they graduate. So far, there are still some problems in teaching ideas and teaching measures, such as: the slow development of the course, can not keep pace with the times; students lack of knowledge and application of standard components; ignore the importance of sensors, electronic control systems, ergonomics, design and mechanical design courses and the effective connection; in the mechanical design process of the layout and installation of lines and pipes are not In the process of mechanical design, the layout and installation of lines and pipes are not fully considered; the concept of precision design is lacking, etc.

In response to the above-mentioned problems in the Mechanical Design course, new teaching ideas and specific teaching measures are proposed, i.e., new innovative teaching reform ideas for this course’s student training concept as well as training methods and lecture arrangements, as follows.

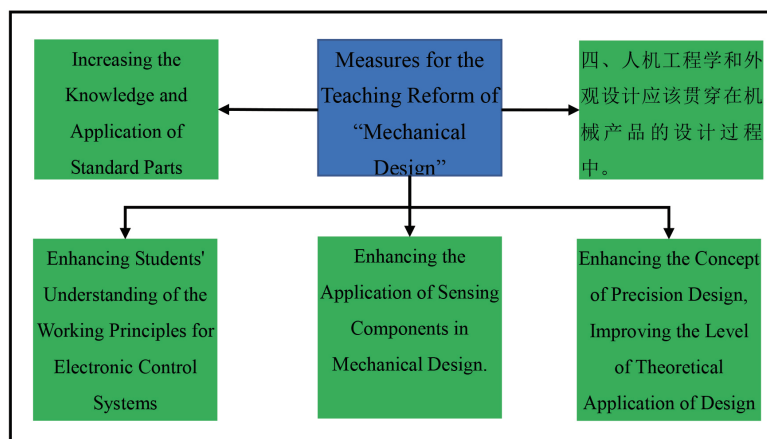


Fig. 2 Framework diagram of educational reform measures for the course “Mechanical Design”

(I) Increasing the cognition and application of standard parts and improving the efficiency of mechanical design

Students in the process of mechanical product design, after completing the transmission scheme design, there is a greater problem for how to achieve the specific design of mechanical equipment. Students in the professional course of study, contact with the standard parts only a few conventional standard parts such as bolts, nuts, gears, bearings, etc., the lack of knowledge of the selection of most standard parts, lack of their own design of non-standard parts and standard parts combined to achieve the intended design function of mechanical products. With the high speed development of China’s manufacturing, the division of labor is becoming more and more detailed, the degree of intelligence is getting higher and higher, standard parts and components, standard outsourcing parts and other aspects have made great progress. In addition to the standard parts listed in the Mechanical Design Manual, the application of a variety of new standard parts is increasingly common. The emergence of new standard parts can efficiently and accurately achieve the functions set by mechanical products; numerous new standard parts manufacturers have developed a large number of standard parts, such as linear motion modules, electric cylinders, etc.

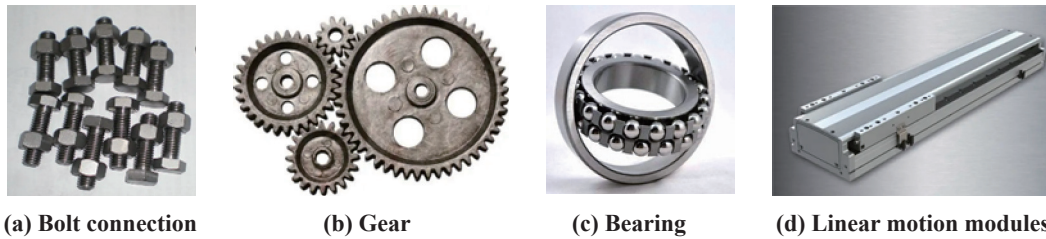


Fig. 2 The common standard parts

(II) Enhancing students' understanding of the working principle of the electronic control system

Undergraduates majoring in machinery are more inclined to the traditional mechanical design lack of consideration of the impact of electrical control on mechanical design in the design of "Mechanical Design Course", and the knowledge of electrical control only stays at the level of understanding its functions. In addition to the basic knowledge of stepper motor and PLC, mechanical students have little understanding of electrical components and electronic devices, resulting in the lack of understanding of electrical components and electronic devices in the process of mechanical design and manufacturing of mechanical products. selection, let alone how to connect it with the mechanical part. In order to solve the above bottleneck problem, in the teaching reform, in addition to mastering the knowledge of electrical control, students should also increase their understanding of the electrical control system and electrical and electronic components.

(III) Enhancing the application of sensing components in mechanical design, and improving the level of specialization, intelligence and modularization of equipment

Intelligent manufacturing is the main development direction of industrial development, and mechanical design and manufacturing will continue to move towards the direction of intelligence. In the process of mechanical design and application, it is an important application of intelligent mechanical design to effectively monitor the operation status and parameters of each transmission link, and to collect and analyze the data obtained by monitoring. The mechanical undergraduate students lack professional sensor courses, and the only sensor courses only explain the basic principles of some sensors, and do not introduce them in detail. Students lack awareness of the functions and application scenarios of sensors, and cannot effectively connect them with mechanical components. In response to this problem, the school hours can be appropriately increased to provide students with sensor knowledge training, including the introduction of sensor functions and application scenarios. At the same time, a research link on sensors is added, so that in the process of mechanical design and manufacturing, the integration of intelligent components such as sensors and mechanical design and manufacturing can be realized, thereby improving the intelligent design and application level of mechanical products.

(IV) Ergonomics and appearance design through the whole design process of mechanical products

In the process of mechanical design, students have a common problem, that is, although the designed mechanical product can achieve the predetermined function, it may not conform to the principle of ergonomics, or it may not meet the basic design requirements. The objective reason for this problem is that ergonomics and design are not used as the main courses to train students in the professional curriculum of mechanical majors. The "Mechanical Design" course needs to design usable mechanical products, and it is imperative to carry out ergonomic design and appearance design for them. It is possible to appropriately increase the ergonomics and appearance design explanations during the school hours, so that the students can fully consider the main design factors of ergonomics and appearance in the design process, so as to achieve the design requirements that the most basic equipment is operable and the appearance is not ugly.

(V) Enhancing the concept of precision design, improving the theoretical application level of design

In the process of mechanical design, in addition to the above-mentioned common problems, there is also a common problem, that is, students do not apply basic mechanical design theory to calculate, check and optimize the designed products when carrying out mechanical design. Therefore, when contacting the course "Mechanical Design", the idea of precision design must be instilled in students throughout the process, so that students should not only consider how to realize their predetermined functions in the process of designing mechanical products, but also fully consider Whether the designed components meet the check standard. Let students remember that each part is related to the overall design level of the mechanical product. Make students pay attention to every detail in the whole process of mechanical design.

4.CONCLUSION

In the context of "Made in China 2025", this paper introduces the teaching reform measures of the "Mechanical Design" course in applied undergraduate colleges and universities, that is, by appropriately increasing the number of hours of explanation and integrating the relevant course knowledge of intelligent manufacturing into the course, and arranging some necessary The practical work of mechanical design, improve students' cognition and application level of standard components, enhance the effective connection between electrical control system and sensor components and mechanical design products; increase the ergonomics and appearance design in the process of mechanical design The proportion of the medium; enable students to master the design concept of excellence. Through systematic teaching reform, students can acquire comprehensive mechanical design knowledge and methods through the study and practice of this course, can design mechanical products more efficiently, improve the level of mechanical design, and adapt to the environment of "Made in China

2025”.

REFERENCES

- [1]Ma Ke, Yuan Minghai, Zhang Jinghui. Discussion on Mechanical Manufacturing Equipment Design Method Oriented to Made in China 2025 [J]. Value Engineering, 2018, 37(20): 248-250.
- [2]Ding Xiaohong, Li Haolin, Qian Wei. Cultivation Mode of Mechanical Innovation Talent Based on Outcome-oriented Education[J]. Research in Higher Education of Engineering, 2017(01): 119-122+144.
- [3]Xiao Zhifeng, Wu Nanxing. Exploration on Teaching Reform of Excellent Program of “Basic Theory and Practice of Machinery Manufacturing” [J].China Electric Power Education, 2013(23): 87-88.
- [4]Liu Fucong. Exploration on the reform of machinery manufacturing equipment design curriculum under the environment of intelligent manufacturing[J]. Course Education Research, 2020(47): 112-113.

Education reform Project:

1. Jiangxi Provincial Key Project of Higher Education Reform Research “Reform Exploration of Ceramic Characteristics and Mechanical Principle, Mechanical Design and Comprehensive Practical Ability Courses under the Background of Double First-class Construction” (JXJG-19-11-1).
2. Teaching Reform Research Topic of Jingdezhen Ceramic University “Research on Ceramic Machinery and Equipment Curriculum Reform under the Background of Engineering Education Certification” (TDJG-20-Y12).
3. Provincial Project of Teaching Reform Research in Jiangxi Universities “Intelligent ‘Organic’ Classroom Construction and Personalized Teaching Model Based on Big Data -- A Case Study of Mechanical Basic Course Teaching” (JXJG-18-11-12).