Adult and Higher Education (2024)
Clausius Scientific Press, Canada

DOI: 10.23977/aduhe.2024.060602
ISSN 2523-5826 Vol. 6 Num. 6

Exploration and Practice on Teaching Model of Mechanical Disassembly and Measurement

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Keywords: Mechanical disassembly, Measurement, 3D modelling, 3D printing

Abstract: In order to improve the theoretical knowledge application level and practical ability of mechanical major students, the existing problems and reform practices were discussed about experimental teaching of mechanical disassembly and measurement. By analysing the teaching status and its shortcomings, 3D modelling and assembly simulation, 3D printing and other modules were introduced into the experimental course, and specific implementation methods were explored. Research shows that these reform measures have significantly improved students' spatial thinking ability and comprehensive application ability, and enhanced teaching effects.

1. Introduction

Mechanical disassembly and measurement is an experimental course in mechanical majors, which allows students to directly understand and experience the importance of the construction, maintenance and repair processes of mechanical equipment, and provides them with real-world application scenarios [1, 2]. Through hands-on operation, you can have a clearer understanding of the working principle of the mechanical system, thereby better mastering the knowledge learned in the classroom. The purpose of the experimental course is to cultivate students' practical skills and problem-solving abilities. When faced with the disassembly and assembly of actual mechanical equipment, students may encounter various challenges and problems and need to flexibly use the knowledge they have learned to solve them. This exercises their ability to think logically and analyse problems, and at the same time improves their manual skills and operational abilities. Normally, such experiments require students to cooperate with each other, discuss together, and divide work. This exercises their teamwork spirit, communication skills and collaboration skills, which are indispensable skills in future work [3, 4].

As a national first-class undergraduate major construction site, Mechanical Design, Manufacturing and Automation Major and Vehicle Engineering Major of University of Shanghai for Science and Technology both have mechanical disassembly and measuring experimental courses. This course draws on the engineering education professional certification concept, combines the professional curriculum system and professional characteristics. Based on existing teaching resources, we continue to promote the reform of experimental content and teaching methods. Distinctive features have been formed in terms of experimental module design and teaching effect evaluation.

2. Experimental Content and Construction Ideas

Lagging technological updates is a major problem in traditional mechanical disassembly and assembly courses. Technology in the field of machinery is changing with each passing day, intelligent manufacturing and digital technologies are constantly emerging. Experimental courses involve a lot of hardware equipment, so the teaching content cannot be adjusted in time to enable students to keep up with the development of the latest technology. At the same time, the experimental course has a relatively short duration, and it is difficult for students to obtain sufficient practical experience and better theoretical applications within the limited experimental time.

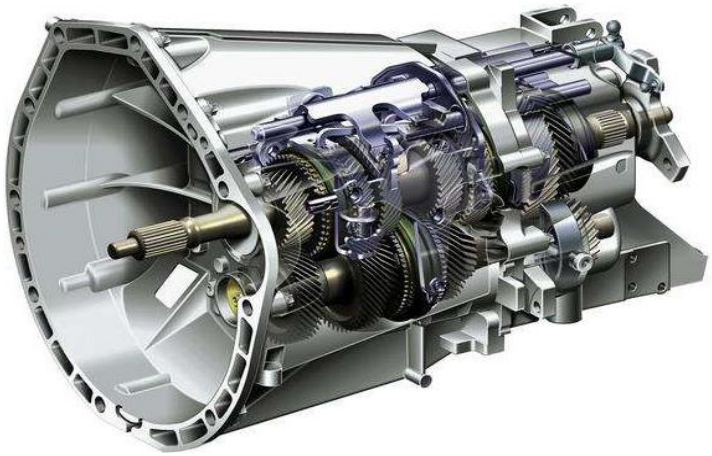

Figure 1: Manual transmission of a certain automobile

The object of this experiment is a manual transmission of a certain automobile model, as shown in figure 1, which mainly includes components such as housing, driving shaft, driven shaft, synchronizer and various gears. The content of the experiment is to disassemble it, measure and model the key parts, and finally put the components back into their original positions. The process mainly includes preparation, disassembly, measurement, modelling, manufacturing and assembly, as shown in figure 2.

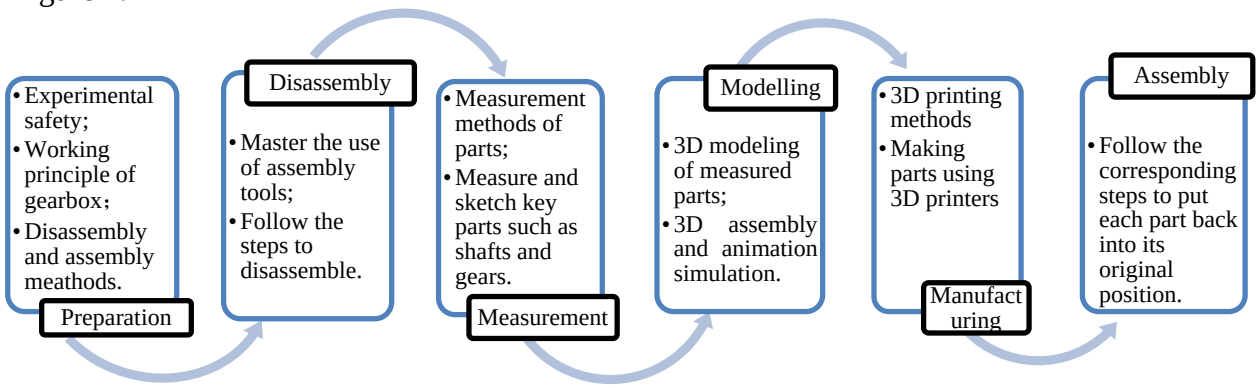

Figure 2: Course content and experimental process

In order to make the experiment class more valuable and attractive, we have carried out the following exploration and practice:

1) In the preparation stage, a video teaching resource was produced to show the actual process of disassembly and assembly of the gearbox. Students can better understand each step by watching the video and familiarize themselves with the experimental process in advance. The simulation software is used to provide a virtual disassembly and assembly training platform, allowing students to operate through virtual experiments before actual operation. It will improve the disassembly and assembly

efficiency and safety, and reduce errors in actual experiments.

2) After the measurement stage, the three-dimensional modelling module is added to require students to convert sketches into 3D models by CAD software, then perform assembly and animation simulation. Furthermore, they will have a deeper understanding of the structure and principle of the gearbox, and familiarity with the disassembly and assembly steps.

3) Based on the established three-dimensional model, use 3D printer to complete the physical production of key components and further assemble them. Due to the large size of the disassembled and assembled objects, they cannot be printed directly and are generally reduced in proportion;

4) We established a regular experimental improvement mechanism, collect feedback from students and teachers, and continuously optimize experimental content and teaching methods according to actual conditions.

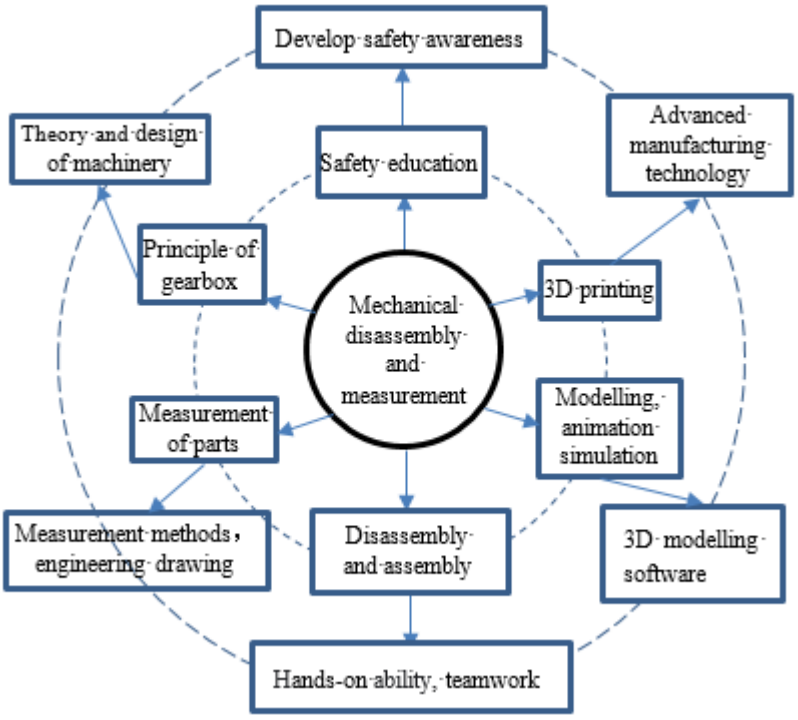

Figure 3: Knowledge graph of mechanical disassembly and measurement

3. Main Teaching Reform Measures and Features

3.1 Update Course Content

With the development of society and technology, the structure and significance of automobile gearboxes are constantly changing. During the teaching process, the teaching content is constantly updated. New teaching plans and experimental content are compiled based on actual cases and the latest technology. And the ratio of theory and practice is reasonably arranged to enhance the practicality and cutting-edge nature of teaching. For example, automatic transmissions, new energy vehicle transmission systems are added to the course and implemented in stages from basic theory to practice. The main content modules and knowledge points of the course is shown in figure 3.

3.2 Improve Teaching Methods

Students are required to learn theoretical knowledge by themselves before class, and conduct practical operations and discussions in class. Through pre-class preview, students can enter the class

with questions and improve class efficiency.

The internal structure and working principle of the gearbox are displayed through 3D animation, allowing students to intuitively understand the complex mechanical structure. They can learn the disassembly and assembly process of the gearbox by videos and animations.

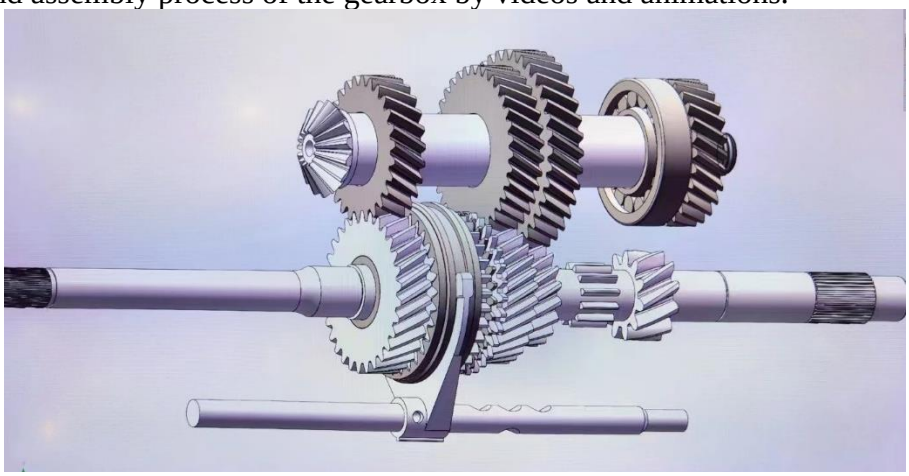

Figure 4: 3D model and animation of transmission part

3.3 Strengthen the Application of 3D Modelling Technology

After disassembling the gearbox, students use tools to measure the dimensions of components such as shafts, gears, and keys, and draw sketches. Then, 3D software is used to perform modeling and assembly of components as shown in figure 4, and then generate 2D engineering drawings. Based on the three-dimensional model, a gear change animation simulation is produced. Through actual measurement and three-dimensional modeling, students can gain a deeper understanding of the structure and assembly relationships of components and improve their spatial thinking abilities. By using the virtual assembly function of 3D modeling software to simulate the assembly process of the gearbox, they can understand the precautions and potential problems during the assembly process in advance and improve the success rate of the actual assembly.

3.4 Improve Teaching Staff

Teachers are regularly organized to participate in industry training to learn about the latest technological trends and improve teachers' professional level and practical capabilities. At the same time, corporate engineers and technicians are hired as part-time teachers to enhance students' and teachers' understanding and mastery of practical work.

4. Conclusion

Through the above exploration and practice, students' hands-on ability and spatial thinking ability have been significantly improved, and they can become more proficient in disassembly and assembly of gearboxes. The teaching effect has been significantly improved.

In the future, we will further strengthen cooperation with enterprises and introduce more practical projects and case teaching to improve students' comprehensive quality and professional competitiveness. At the same time, we continue to explore and apply more advanced technologies, such as virtual reality and augmented reality, to provide new ideas and means for teaching reform.

References

[1] Cai Xiaojun, Liu Xiangchen, Guo Lifeng. Design of mechanical disassembly and surveying experimental platform [J]. University Education, 2016, (06): 102-103.
[2] Wang Li. Development and practice of mechanical disassembly and surveying courses based on systematic work process [J]. China Educational Technology and Equipment, 2019, (14): 122-126.
[3] Li Yingfei. Design of a Mechanical Professional Training and Teaching System Based on 3D Modeling [J]. Digital Technology and Applications, 2022, 40 (08): 168-170.
[4] Xie Qingbing, Li Hao. Reform and Practice of Mechanical Experiment Teaching Based on the Training of New Engineering Talents [J]. Equipment Manufacturing Technology, 2024, (05): 100-102.