Exploration and Application of 3D Modeling Software in Practical Teaching

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Abstract. The practice of traditional auxiliary engine comprehensive training mainly focuses on equipment disassembly, key component introduction and theory description. The training content also lacks equipment structure design and engineering software use. Due to the COVID-19, students can not enter the laboratory to disassemble on-site equipment and they only can learn the courses through online learning. It greatly affects the students' understanding of the structure principle and main components of the equipment. Aiming at the deficiencies of the training practice and the online teaching needs of the practice courses under the COVID-19. We introduce 3D modeling software into the practical teaching. By this way, students can use 3D software to disassemble equipment and improve components. It will deepen the students' understanding of the equipment structure and the connection form of components. It also enhances students' innovation ability and software using ability.

Keywords: 3D modeling software · equipment assembly and disassembly · practical teaching

1 Introduction

At present, the cases of introducing simulation technology into practical teaching are very extensive. And a large number of simulation software can be used, such as AMESim, Matlab, Solidworks, etc. [1–4]. In terms of virtual simulation teaching, Guangdong Han and others built a simulation model of hydraulic valves based on AMESim, which improved students' understanding of hydraulic valves and improved teaching quality [5]. Wentao Jia and others proposed the innovative path of virtual simulation experiment teaching in higher education, providing reference for the method of virtual simulation experiment teaching [6]. Jiehong Zhu used AMESim simulation platform to establish simulation models of pressure reducing valve, swashplate axial piston pump and simple hydraulic circuit, and carried out simulation analysis [7]. Qihui Zhang used Python and AMESim to build the simulation model and described the application of the model in hydraulic and pneumatic practice teaching [8]. In terms of virtual reality mixed teaching, Lixiang Zhu and others studied the virtual reality mixed teaching mode and proposed the advantages of this teaching method [9]. Yinghong Luo constructed a mixed teaching model of higher education, and applied this model in practical teaching [10]. For

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the quality evaluation of online teaching, Xiaoyan Lu built an online teaching quality evaluation system for higher education [11]. Zhuo Liu established a improved teaching evaluation system for higher education in the new development stage [12]. These experiences provide reference for the construction of the online teaching quality system.

By introducing 3D modeling software into the practical teaching, improve the students' ability to use software. In the process of assembling and disassembling the equipment, students can better understand the internal structure, connection form and working principle of the equipment. In this way, students' study interest is enhanced, and students can have a corresponding understanding of the actual structure design of the project. Improve students' comprehensive ability through this teaching model.

2 Practice Teaching

Aiming at the shortcomings of the traditional practical teaching of auxiliary engine comprehensive training, and the online teaching need of practical courses under the COVID-19. Use 3D software to build 3D model of pump, valve, motor and key components and upload these models to network database. The Fig. 1 is the 3D model of gear pump after disassembly, and the Fig. 2 is the 3D model of gear pump after assembly. After downloading, students can assemble and disassemble according to the practice manual and demo videos. And set some faults in some parts. By this way, students can optimize the parts in the assembling and disassembling work. When finish the assembling and disassembling work of the 3D model, students can enter the laboratory to disassemble and assemble the on-site equipment.

Through the assembly and disassembly of 3D model of equipment and the actual equipment on site, it enhances students' ability to use 3D model software and have a deeper understanding of these equipment. And they will have a clearer understanding of the connection form between different components. In the process of fault analysis and propose solutions, students can have a clearer understanding of the causes of equipment failures. These trainings will be helpful for future work and study.

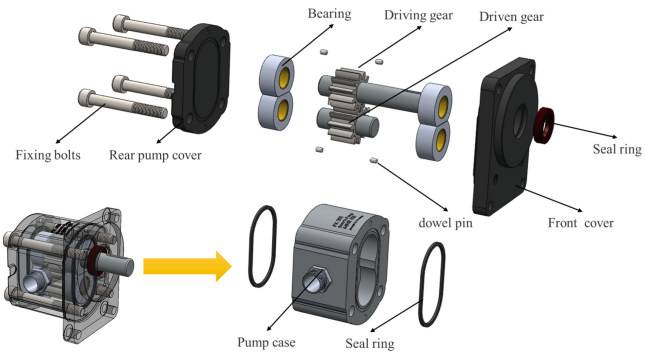


Fig. 1. 3D model of gear pump after disassembly

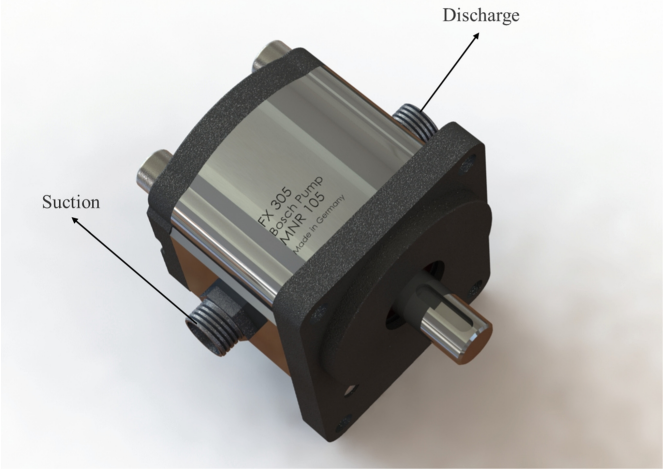


Fig. 2. 3D model of gear pump after assembly

3 Embodiment

According to the training objectives of the auxiliary engine comprehensive training, the implementation plan of the course is divided into four parts. 1) Take students as the center and reform the teaching mode. Enhance students' sense of participation and initiative. 2) Combine diversified teaching methods and integrate 3D models into practice teaching. Cultivate students' structural design ability and software use ability, and improve the training effect; 3) Train students' practical ability and improve the course practice assessment mechanism by 3D software operation and on-site training. 4) Improve the teaching model according to students' performance in class and feedback after class. The technical route of this project is shown in Fig. 3.

3.1 Taking Students as the Center and Enhancing Learning Initiative

The auxiliary engine comprehensive training practice course is based on the students master the basic theoretical knowledge and basic practical ability. Take this as the premise, let students master the structural principle, assemble and disassemble skill and failure analysis ability of complex ship auxiliary equipment. So, the initiative of students' participation in practical training courses is the key to curriculum exploration. The Fig. 4 shows the assembly completed by students. The Fig. 5 shows the disassembly completed by students. The Fig. 6 shows the student optimization component with change the diameter to 18mm. The Fig. 7 shows the student measures gap. After students have completed the process of equipment structure design, 3D model assembly and disassembly, animation simulation, on-site assembly and disassembly and debugging, students will have a deeper understanding of the theoretical knowledge they learned, and improve their professional skills, theoretical accomplishment and comprehensive quality. Students can use 3D modeling software to assemble and disassemble mechanical structures and make animations simulation. They can also use the network, library and

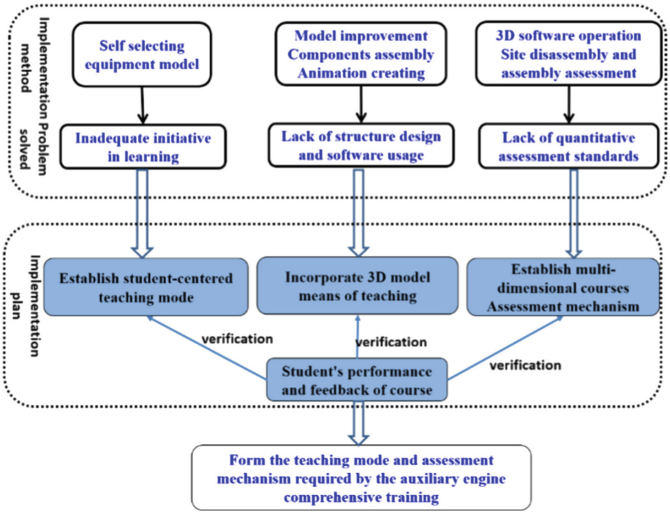


Fig. 3. Technical route

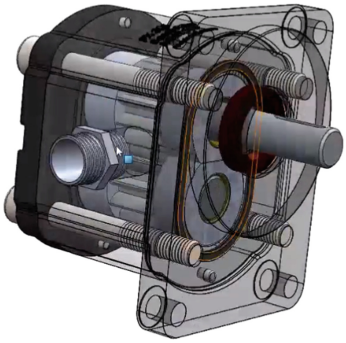


Fig. 4. Students complete assembly

other channels to access the relevant information to improve the parts, so as to give full play to students' innovative and practical abilities. Because students are not affected by teachers' design ideas, they can use their professional knowledge and the innovation to design the parts and connection methods that they are interested in. By this way, students' learning initiative is enhanced, and their sense of participation and achievement in the practical training courses are increased.

3.2 Combining Diversified Teaching Methods to Improve the Training Effect

With the development of information technology, virtual simulation software has been integrated into the practice teaching of different disciplines. In order to improve the teaching effect of the auxiliary engine comprehensive training and meet the teaching needs under the COVID-19. The 3D modeling software is integrated into the auxiliary

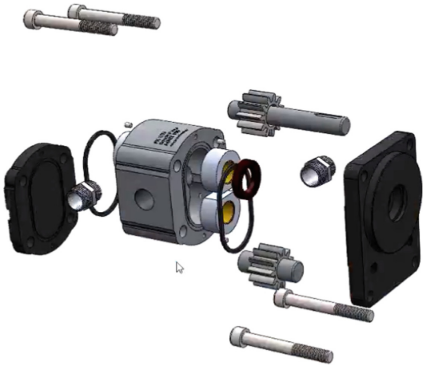


Fig. 5. Students complete disassembly

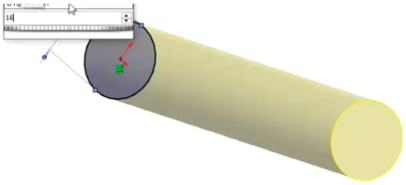


Fig. 6. Students optimize components-diameter change

engine comprehensive training practice teaching. According to existing equipment in the laboratory, teachers build 3D model and set corresponding errors intentionally in some parts and upload these models to the network database. Students will correct these components according to the prompts and optimize connection through their innovation and complete the assembly and disassembly of the equipment.

3.3 Improving the Practice Assessment Mechanism

Establishing a perfect examination and evaluation system is the key to ensure the teaching quality of the auxiliary engine comprehensive training. According to the general process of auxiliary equipment design, the score of auxiliary engine comprehensive training is divided into 5 parts: 3D components optimization, 3D models assembly and disassembly, animation simulation, on-site assembly and disassembly, faults analysis. Among them, 3D component optimization accounts for 10% of the total score, 3D model assembly and disassembly accounts for 30%, animation simulation accounts for 10%, on-site assembly and disassembly accounts for 30%, and fault analysis accounts for 20%.

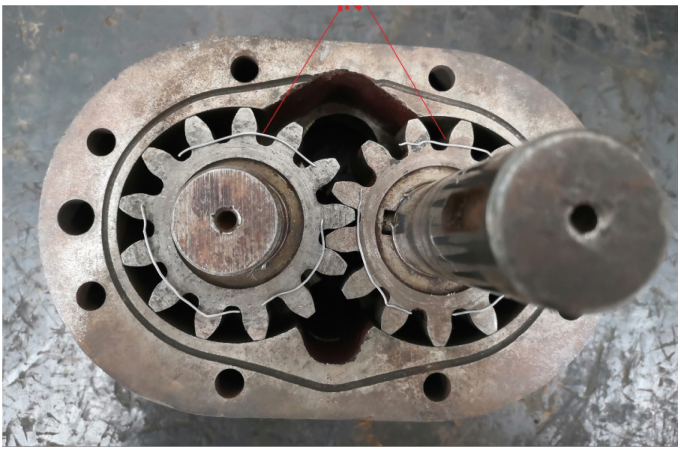
3.4 Improving Teaching Model

After the students have completed the reformed auxiliary engine comprehensive training course, teachers will collect and sort out students' feedback. Optimize the auxiliary

a. Meshing clearance

b. Radial clearance

Fig. 7. Students measure gap



c. Axial clearance

Fig. 7. (*continued*)

engine comprehensive training course according to students' performance of 3D component optimization, animation simulation, on-site disassembly and assembly, fault analysis and the student's evaluation of the course. In this way, further improve the teaching quality, and enhance students' ability to use software, design mechanical structure and practice.

4 Conclusions

By introducing 3D modeling software into the practical teaching of auxiliary engine comprehensive training, it allows students to intuitively understand the equipment structure and the components connection relationship even if they are not in the training site. This will meet the training objectives of the auxiliary engine comprehensive training. By this way, students operate by themselves. It enhances students' sense of participation and achievement, and improve students' learning enthusiasm. It has trained students' ability to learn and use software, and laid a solid foundation for future study and work.

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References

1. Z. Long, W. Shiwei, Research on the Application of AMESim Software in the Teaching of Mechanical Principle Course, Education and Teaching Forum, vol. 08, 2019, pp. 193-194.
2. H. zongzong, G. yufei, Flow Field Simulation of Filter Screen Based on FLUENT, Ship & Boat, vol. 02, 2020, pp. 58–62.
3. W. Xueting, W. Zhangyong, G. fei, Cooling Simulation of Hydraulic System Fuel Tank Based on AMEsim, Software, vol. 1, 2020, pp. 21–23+28.

4. B. Yinqian, G. Panke, R. Rui, Application of AMEsim based simulation technology in hydraulic system, Sci-Tech & Development of Enterprise, vol. 10, 2019, pp. 55-56.
5. H. Guangdong, Y. Jie, W. Shenghai, Application of AMESim in hydraulic valve teaching, Education modernization vol. 8, 2021, pp. 117-119.
6. J. Wentao, L. Junyi, The innovative path of virtual simulation experiment teaching of new liberal arts in Higher education, China Higher Education, vol. 3, 2022. pp.3.
7. Z. Jiehong, Application of AMESim hydraulic modeling and simulation in practical teaching, Equipment Manufacturing Technology, vol. 09, 2020, pp. 95–97+108.
8. Z. Qihui, L. Cong, Y. Lirong, Application of Python and AMESim in hydraulic and pneumatic practice teaching, Education and Teaching Forum, vol. 47, 2020, pp. 222-223.
9. Z. Lixiang, L. Ruiqiong, P. Weishao, "Research on the virtual and real mixed teaching mode of digital and electrical experiment course, Education Modernization, vol. 55, 2020, pp. 39-41.
10. L. Yinghong, "On the construction and practice of mixed teaching mode in higher education," Higher Education Exploration, pp. 48–55.
11. L. Xiaoyan, "Construction of online teaching quality evaluation system in higher education," China Higher Education, vol. 10, 2021, pp. 3.
12. L. Zhuo, Establishing and perfecting the teaching evaluation system of higher education in the new development stage, China Higher Education, vol. 08, 2022, pp. 54-55.