The Application of 3D Printing Technology in the Teaching of Mechanical Design Fundamentals in Higher Vocational Education

Jie Liu, Yufan Hou, Lingfeng Xiao, Shiyu He, Jiaqi Li
Guangzhou Huali City and Technology Vocational College, Guangzhou 511325, China.

Abstract: 3D printing technology is an emerging technology in recent years, which can achieve rapid display of objects through the feeding method. It has been widely used in various industrial sectors. Higher vocational and technical colleges are one of the important ways to cultivate higher technical personnel from various industries. They must keep up with the pace of educational reform and introduce 3D printing technology into corresponding classrooms. Under the guidance of the course "Fundamentals of Mechanical Design", this article utilizes 3D printing technology to apply common PRO/E to products, achieving various motion mechanisms, making the originally monotonous classroom teaching lively and allowing students to immediately showcase their creativity.
Keywords: 3D Printing Technology; Mechanical Design; Basic Teaching

Introduction

3D printing technology has gradually entered higher vocational and technical learning, and has been widely used in various industries, allowing students to gain more fun and knowledge in the classroom. Mechanical design is a discipline primarily focused on engineering, and its application is to improve students' comprehensive design and innovation abilities, thus creating new requirements for its application in teaching.

1. The development status of mechanical design vocational education

1.1 Lack of expandability in extracurricular time

Due to time constraints, the main job in the classroom is to teach basic theories and theories, such as mechanical design. In conventional teaching, traditional professors use screw type static connections and V-belt drives, but their knowledge is no longer suitable for today's mechanical design needs. In classical teaching of basic mechanical design theories, there is a lack of cutting-edge knowledge, hot topics, and knowledge related to mechanics. Due to the increasing application of 3D printing technology in the education industry, in order to adapt to students' self-learning ability, it is necessary to combine 3D printing technology with machine manufacturing technology.

1.2 Lack of ability to explore and create problems

Due to the difficulty in introducing "metal physics" into the classroom in the basic course of mechanical design, students can only observe in the laboratory and cannot use problem-solving methods for practical operations. Therefore, it is necessary to guide students to actively participate in the design of teaching aids and 3D printing in the teaching of mechanical design basics, cultivate students' thinking about problems and independent creation, in order to meet the requirements of mechanical design.

2. Basic teaching methods of mechanical design

2.1 Classroom preview based on introducing questions and online resources

A teaching outline for 3D printing technology has been developed using existing training equipment and in conjunction with the students' strengths. Select the corresponding questions according to the different subjects learned by the students. Teachers should set up situations in the classroom to create empathy or cognitive conflicts among students, propose topics that can arouse students' interest,

and appropriately organize controllable and extended teaching according to the course topics and priorities. Through various channels such as textbooks, literature, course platforms, and the Internet, the pre classroom knowledge and objectives are linked to tasks. Through answering questions and self testing, the effectiveness of classroom preview is tested. By utilizing the mechanical principles learned and combining them with 3D software, a 3D printing technology was designed and assembled to achieve mechanical motion. Regardless of the complexity of its structure and process, it can be manufactured using 3D printing technology in a short period of time, greatly improving work efficiency, enhancing product design capabilities, and fundamentally solving industrial design capability problems.

2.2 Interactive classroom teaching based on thematic surveys

Teachers will promptly identify the shortcomings and problems that students understand or master based on their classroom teaching effectiveness, and conduct group communication accordingly; The teaching method of counselors provides students with targeted problem-solving, deepens the connotation of classroom teaching through teacher-student interaction and student interaction, and deepens, expands, and applies students' knowledge. In the "Introduction to Mechanical Design" course, a group discussion was conducted on the design of common mechanical mechanisms such as screw drive, synchronous belt drive, wire feeding mechanism, and nozzle in FDM 3D printing desktop computers, and some of the existing problems were analyzed.

Based on the professional talent training program learned by college graduates and integrated teaching, a course internship was set up, which was divided into a two week comprehensive internship project - the design of a first level reducer. This course consists of 6 groups, each consisting of 6-8 people. The requirements for the gearbox are: 50 computer CAD units; 6 3D printers (vernier measuring instruments); Steel ruler, diagonal pliers, electric grinding pen, mixed file (PLA, 4A printing); Using the UG program, according to the teaching content and requirements assigned by the teacher, the structure of the gearbox was optimized (mainly including the input shaft, output shaft, transmission gear, bearings, bearings, bearings, sealing rings, upper and lower gearbox boxes), and the assembly parts were determined according to the actual application requirements; Each team uses UG programs to output the completed charts into STL, and uses cutting software to set various parameters of STL (factors related to printing accuracy, wall thickness, filling, upper and lower thickness, etc.), guiding students to proceed under the guidance of the teacher; Completing the use of a 3D printer: A 3D printer produced by the school will be used for printing (including understanding the printer structure, operating methods, workbench leveling methods, installation and unwinding of PLA materials, folding treatment of PLA materials, clogging of wire feeding ports, etc.). Each team will print the team's model for two days. During the two-day printing interval, students will learn reverse design, Understand how to use reverse design methods, allowing students to learn how to operate 3D scanners and scan non-standard parts, thereby mastering the theory and methods of reverse design; Print out the parts within 2 days, and inspect and assemble each batch of parts, including inspection records of structure, dimensional accuracy, fit, etc. Compare them with the design mode, and make corresponding corrections and analysis for future learning. Finally, within half a day, complete the work of the group (raw materials of the UG model, slicing software parameter setting data, and printed products), and each group will score (group evaluation, 20%). The students will evaluate their daily performance (including classroom attendance, work completion, equipment use, maintenance, site cleaning, and tool cleaning and placement), thereby improving the students' professional literacy, The finished product score of the first level reducer is 30% (including 3D model modeling, software application, quality of printed products, etc.).

3. Basic theory and practice of mechanical design

3.1 Strengthening the three-dimensional effect of education

With the advent of information technology, people's learning habits and methods have shifted from traditional classrooms to relying on the Internet and various electronic terminals for autonomous learning anytime and anywhere. So, under the teaching purpose of mechanical design basics, combining relevant knowledge can create a good teaching environment for teachers, increase classroom atmosphere, and increase students' interest in learning. By utilizing the above two methods, various digital resources of the project can be enriched, making it easier for students to access learning materials and improving the teaching level in the classroom.

3.2 Cultivating Students' Creative Thinking

In order to cultivate students' creative thinking during the learning process, teachers should focus on practical engineering cases

when designing project tasks, supplemented by design and 3D printing teaching, and integrate the content of each chapter. After completing a project task, one can gain a deep understanding of the overall structural scheme design, process design, 3D printing equipment operation, assembly and debugging, and ultimately form a report, which can be analyzed with classmates and teachers. According to the different structures and operating methods of teaching aids, teachers can appropriately integrate different teaching aids into the basic learning of mechanical design, making it have a certain teaching content and enabling students to have better learning and passion. In the teaching of mechanical experiments, appropriate use of books to introduce mechanical structures and make full use of their characteristics as teaching aids for mechanical structures is an important factor in improving teaching effectiveness and quality.

4. Conclusion

The use of 3D printing technology for mechanical structure design can bring the basic principles of engineering into the classroom, stimulate students' strong interest, enable them to experience the joy of mechanical engineering as soon as possible, and enable students to not only master professional technology but also personally experience advanced design processes, forming a positive interaction between knowledge learning and application. It has a certain promoting effect on improving students' professional knowledge, comprehensive quality, and other aspects. Integrating 3D printing technology into relevant classroom teaching methods, conducting appropriate teaching reforms and innovations, can also serve as a reference for other related courses.

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