Application of 3D printing technology in equipment structure teaching

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Abstract. Aiming at the characteristics and current situation of equipment construction teaching, with the help of 3D printing technology, the production, assembly and demonstration of typical equipment model of equipment can be realized, and the teaching effect of equipment construction course can be significantly improved through specific application. At the same time, it puts forward reasonable suggestions for the popularization and application of 3D printing technology in teaching, and provides a reference for the reform of equipment structure teaching.

1. Introduction
The equipment construction course is a kind of professional theoretic professional course with professional theories of vocational technical education and maintenance. It aims to lay a theoretical foundation for the subsequent repair and troubleshooting courses by mastering the construction principles. In the teaching organization, mainly in accordance with the cognitive laws of students, teaching is carried out in the order of the "name-function-performance-structure-work" of each component of the equipment, focusing on the training of students' ability to identify parts, structure analysis, and principle of action And comparative learning ability. However, due to the influence of factors such as teaching conditions and limited support equipment, many construction teachings still use more traditional teaching methods, mainly by means of pictures, teaching aids or physical objects. How to visualize more complicated devices has always been a difficult problem restricting the improvement of teaching effects.

3D printing technology is an advanced technology that is developing at a high speed and is becoming more mature. It is known as "the most iconic production tool to lead the third industrial revolution." Its characteristic advantages have a high degree of fit with the teaching needs of equipment construction. In recent years, with the increasing application of 3D modeling and printing technology, construction teaching has presented more flexible and diverse teaching methods and methods, and also provided more ideas and reference for the reform and update of teaching concepts. This article will introduce the practical application examples of 3D printing technology in the teaching of equipment construction.

2. Introduction to 3D printing technology
3D printing is a type of rapid prototyping technology. Based on the digital files of the model, it uses powdered metal or plastics and other bondable materials to construct objects by layer-by-layer stacking and fusion. The process is to read each layer of data from the STL file (stereolithography file format) generated by the CAD three-dimensional model. As a step in the printing process, the CAM
system passes the 3D according to the materials used, the forming path and the manufacturing parameters. The print head performs the manufacturing process.

As an emerging manufacturing method, the difference between 3D printing and conventional processing methods such as turning, milling and grinding is that the consumables are melted or solidified in the shape generated by computer modeling during manufacturing, so that they are stacked and increased on the printing platform. Height, ultimately forming the parts or components that the designer needs. This method greatly saves materials and does not produce a lot of processing waste.

Using 3D printing technology to prepare metal parts, compared with traditional manufacturing technology, has the following outstanding advantages:

1. There is no need for large-scale blank preparation and mold processing, and no large or super large industrial equipment is required;
2. The parts have the characteristics of fine grains, dense structure and uniform composition of the rapidly solidified structure, and excellent comprehensive mechanical properties;
3. Achieve near-final forming without molds, greatly save materials, low manufacturing cost and short cycle;
4. A wide range of applicable materials can be used to prepare metal materials that are difficult to process using traditional methods;
5. In the manufacturing process, the components and organization of different parts can be designed according to the actual use of the parts, to improve the comprehensive performance of the parts and expand the scope of application;
6. It has a high degree of flexibility and quick response to component design to reduce the risk of new product development.

3. 3D printing equipment model and application

In the past teaching, because the reliability of the control device is directly related to the normal operation of the vehicle, the coordination and movement of the parts are relatively complex, which is the most difficult part of the construction of the lecture. At the same time, the control device is located inside the car body, and the visibility is poor and the shape of the parts is different. It takes a lot of energy in the teaching process but the effect is limited.

In order to solve the above problems, the application of a certain vehicle control device model in construction teaching is taken as an example to make an exploration. The establishment of the model is divided into two stages: data modeling and part printing.

3.1. Data modeling.
Before modeling, first obtain the true dimensions of each part of the operating device through parameter measurement or consulting drawings, etc., use SolidWorks software to sketch the parameters for parametric design, and use solid modeling functions such as stretching, rotation, lofting, and scanning to construct the operation Solid three-dimensional model of each part of the device. Finally, the stl design file of the firing device is exported.

3.2. Parts printing.
First import the stl design files of each part of the control device into the 3D printing software Cura, and then set the printing options of the 3D printer step by step and execute the printing program to obtain the control device parts model.

At this stage, the cost of 3D printing materials and the practical effect of printing models are issues to be considered in part printing. ABS plastic is currently the most common printing material, and it has the characteristics of more color options and lower cost, which can fully meet the needs of different parts and key display in the teaching of equipment construction.

3.3. Practical application.
In the actual teaching application process, combined with teaching needs and student abilities, some top students with high learning interest and strong professional quality are specially selected. In the teaching of device construction, it guides them to view the drawings, personal measurement, instructor-assisted modeling, and printing, and expands the scope of teaching display from plane to three-dimensional, further deepening the understanding and grasp of the content learned.

4. Application effect analysis and prospect
Through the application, students' enthusiasm for learning equipment and learning efficiency are greatly improved. At the same time, based on the application results of 3D printing technology in construction teaching, students' mastery of the working principle of the equipment learned and the skill level of repair and troubleshooting have also been improved.

4.1. Deepen content control and enhance learning effect
3D printing technology can provide a more intuitive understanding and a deeper experience for the study of equipment structure. It can deepen the students' grasp of the structure content, significantly improve the teaching effect, and have huge development space.

4.2. Overcome equipment shortages and improve teaching methods
3D printing technology can scale important parts in equal proportions, enlarge or reduce them, and print teaching models, which can effectively overcome practical problems such as insufficient equipment; at the same time, the materials generated based on 3D modeling technology can also be perfected as 3D Courseware and 3D wall charts are used in theoretical teaching, and the teaching methods will be effectively improved.

4.3. Mobilize learning initiative and cultivate solidification ability
Through the application of 3D printing technology in teaching, students' ability of active learning and autonomous learning is effectively enhanced. The ability of students to transform and apply what they have learned is also solidified, which also helps to train students' thinking methods and innovative spirits, and provides assistance for solving practical problems of equipment support.

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