
The reform and innovation of the training course of additive manufacturing in colleges and universities

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Abstract

Additive Manufacturing is one of the main technologies to promote the progress of manufacturing technology in the future, which the production costs are lower, was applied in wider field, and machined complexity was larger compared with traditional machining. Recently, Additive Manufacturing has been used as a training course to improve students' skill in colleges and universities. The training course should be combined with professional training course for different major based on the advantages of Additive Manufacturing, adequately. The reformed results shown that the course exercise of mechanical design and training course of casting can be integrated into the additive manufacturing for mechanical engineering department, this reform is very important measure to develop students' innovative ability.

Keywords

Additive manufacturing; Reform and innovation; Practical teaching; mechanical design.

1. Introduction

Additive Manufacturing (AM) also known as 3D printing, the manufacturing method is create a three-dimensional object by accumulated layer on layer. Compared with the traditional machine (removing materials), AM has the easy machining, low production costs, larger complexity of the processing and so on. The technical characteristics promote the development and promotion of AM [1-8]. Currently, Additive Manufacturing technology is widely used in many fields such as biomedicine, abrasive manufacturing, construction, rapid prototyping and education. In recent decades, the traditional processing methods can't meet the requirements that the difficulty in the processing of parts was increased during the fabrication procedure. AM as a New manufacturing techniques which has the irreplaceable advantage, so it was widely accepted in the majority manufacturing enterprises, research institutions and colleges and universities [4-9]. Objects can be of almost any shape or geometry and typically are produced using digital model data from a 3D model, without the need for machining or moulds, This technical feature is greatly reducing the production cycle time and increasing productivity. Although, AM technology is still improved to have a good development trend, in material and speed control field. At present, more and more scientific research institutions and universities have put large amounts of money and man power to study its industrial application.

The specific type of AM included Fused Deposition Modeling (FDM), Laminated Object Manufacturing (LOM), Digital Light Processing (DLP), Selected Laser Sintering (SLS), and Stereo

Lithography Apparatus (SLA). Of which, FDM and SLA have advantage in technology, consumables and equipment costs, so were widely applied in universities for training courses [1,2]. However, the training programs were simplification and mechanization in most colleges and universities, and they fail to give full play to their ability to develop students' innovative thinking. This article will discuss the necessity of reform through the course of the Additive Manufacturing training offered by our university. The construction and reform of curriculum system are surrounding the student, utilize school resources rationally, stimulate the motivation of learning and improve the level of interest and consciousness, develop students' ability, provide reference for the teaching reform and implementation of AM.

2. The present status analysis of AM in Training Courses

The AM training courses is mainly the conventional 3D printing training in university. The training content is built three-dimensional model using software and printed it by the 3D printer. The advantage of the courses is easy to learn and wonderful, the student can create products through their own ideas in a short period time. The other advantage is the courses practical training is conducive to large-scale training and it can stimulate the enthusiasm of students [9,10]. The AM training courses content using the simple operation of the equipment, set up a single course, the course aims is the students are easy to learn by merely use modeling software. Since the fall semester of 2014, Guizhou Minzu University has set up an additional manufacturing training course, and the training mode was adopted the "three-dimensional modeling - printing and forming" method. During the practical training, the student's interest in three-dimensional modeling have improved significantly, some students want to print their own production thought learning three-dimensional modeling software. Students' modeling skills are improved through the AM training, but the students' work basically only reflects the strength of the modeling ability, the AM training was in the auxiliary status, was failed to reflect its real value. Therefore, setting the AM training should be according to the different professional training courses. The practical training courses that related to this major are integrated into the course of AM, which forms the practical training mode of multiple practical training courses for a subject.

3. The reform and innovation of the training course of AM

The AM technology include the computer-aided design, automatic control systems and fused deposition modeling, involving more profession, was widely use in all field. The AM training is offered to all major student in Guizhou Minzu University, including mechanical engineering, art and craft design and other professional product design and processing, and the majors should be better grasp the product making process and quality control methods. The molding idea of AM is correspond with the major requirement, so this course is main course of practical training in Guizhou Minzu University. Therefore, this article will discuss the application and reform of the AM training in the major of mechanical engineering, art and craft design in Guizhou Minzu University.

3.1. The course design of mechanical engineering

Due to the students of mechanical majors have good foundations of machinery, the course setting shown consider the multidisciplinary integration and form a comprehensive project. For the mechanics majors, the comprehensive project should include the course exercise of mechanical design, 3D modeling training, 3D printing training, casting training and engineering detection training, the training flow chart is shown in Figure 1.

At present, the content of the course exercise of mechanical design is mainly design two-speed or three-speed transmission, the different of student issues is only reflected in the different parameters, while the structure and style of transmission are basically the same. But this course didn't set the process and detection practical process, it lead to the difference is between the technical documents and the processing technology designed by students (such as the drawing tolerance unreasonable). In the

reform of training curriculums, it requires the students to choose their own subjects of the course exercise of mechanical design, the teacher's task is to provide process parameters and technical guide for students. In the course exercise of mechanical design, the students need to design three-dimensional model that meet with 3D printing and casting process requirements using three-dimensional modeling software. The students should be referred reference, enhance self-study ability, in the case of design difficulties. In the design process, the design drawings should be based on processing accuracy and technology to determine, and checked whether the product meets the drawing requirements. Combining the AM training with the course exercise of mechanical design, casting training and engineering detection training, at the same time considering the entire project processing technology and precision requirements in each training parts, realizing the integration of multiple training courses. Finally, the student score is evaluated by the product quality and operation standard of equipment.

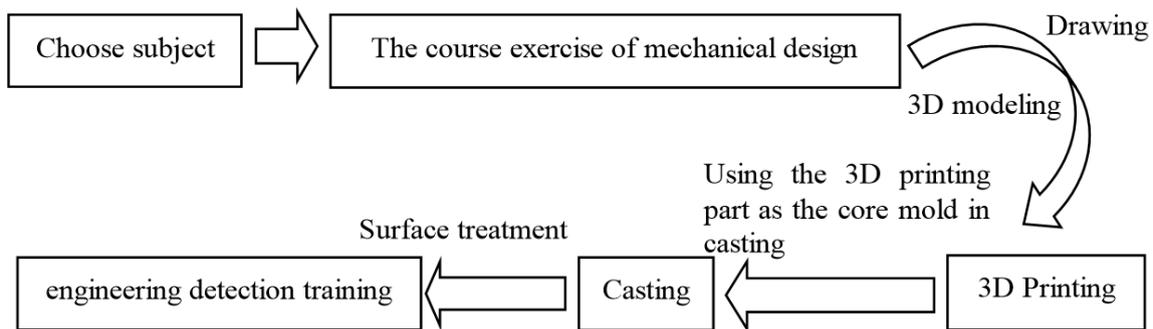


Fig 1 The training flow chart for the major of mechanical engineering

3.2. The course design of the major of art and craft design

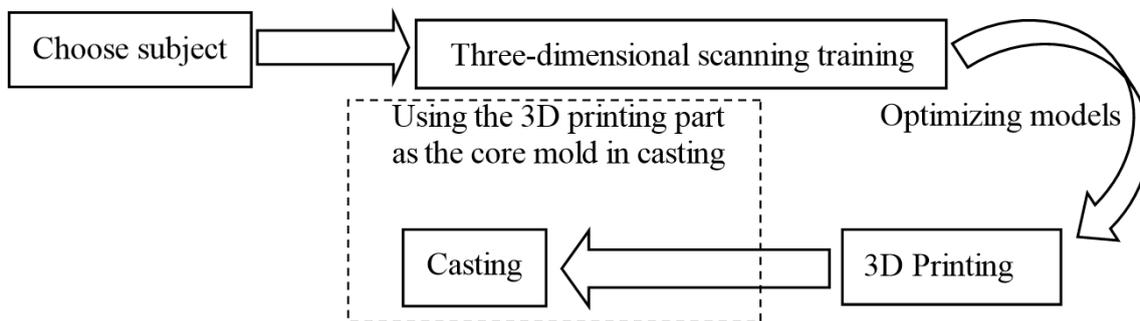


Fig 2 The training flow chart for the major of art and craft design

For the major of art and craft design students, product production is an essential part of practice in Guizhou Minzu University. The practical training course content of producing including the design the production models, hand crafted the sludge shape, plastic film mulch using carbon fiber or glass fiber mothed, curing molding using resin materials. Guizhou Minzu University is locate in minority area, there are a most of students and teachers are ethnic minorities, so the production of ethnic arts and crafts is the important part of the training session. But the structure of ethnic arts and crafts are complex, and the product is difficult, they lead to the practical training is difficult to advance. For such training, we should take full advantage of AM technology, combined with individual characteristics of ethnic arts and crafts, made the corresponding training curriculum reform, the training flow chart shown in Figure 2.

The dotted line in the figure 2 is an optional training project, the 3D printer that used in the training course is FDM, the production which is product using FDM 3D printer is not strong enough, so the casting training has been increased in training program (if the product requires the low strength, we not add the cast training project). Combining three-dimensional scanning technology and AM into the practical teaching of product production, the benefit of this approach is that it base on students' interests, solving the problems that the students are short of interests on practical teaching, improving the quality of practice teaching.

4. Conclusion

The AM technology is of the unique forming way which fused deposition, was widely used in the practice teaching, in colleges and universities. The operations of the equipment are more simple and user-friendly with the development of the automation technology and computer technology, resulting to the training course content is relatively single and relative mechanization. The traditional method that builds a three-dimensional modeling and printing, failing to give full play to their ability to develop students' innovative thinking. the advantages of AM should be considered to combine with other professional training courses adequately, forming an innovative comprehensive training program, improving students' interest on practical teaching. The training course of colleges and universities should be accompanied by reform and innovation.

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