Research on Methods of Cultivating Applied Innovative Talents Based on Additive Manufacture under New Engineering Education

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Abstract: The specialty courses in the course system of mechanical design, manufacturing and its automation, the application skills of CAD/CAE/CAM software and additive manufacturing equipment were combined in this study. In the process of scientific research projects and innovation and entrepreneurship projects, students' innovative consciousness and ability to solve practical engineering problems were cultivated. In the process of practice, a new method of cultivating applied innovative talents based on additive manufacture was explored and formed, and the effectiveness and necessity of talent cultivation model were proved by practice.

1. Introduction

Nowadays, as a new advanced manufacturing technology, add-on manufacturing is affecting the manufacturing industry of our country and even the whole world more and more profoundly [1]. While promoting the quality and efficiency of manufacturing industry, China emphasizes the importance of using advanced manufacturing technology represented by material-added manufacturing to drive and transform traditional manufacturing industry. In recent years, the “National Additive Manufacturing Industry Development Promotion Plan” and “Made in China 2025” have been successively introduced [2,3], with a view to further promoting and strengthening the competitiveness of the product manufacturing industry with advanced manufacturing technologies such as additive manufacturing. . Among them, the cultivation of innovative talents in colleges and universities is the fundamental guarantee for improving the competitiveness of China's product manufacturing industry.

2. The Current Situation of Application of Innovative Talents Training Model

All colleges and universities have conducted in-depth research on the methods of training innovative talents. Focus on the Yangtze River Delta region: Jiangyin Vocational and Technical College has established a 3D printing R&D studio through cooperation with enterprises to carry out 3D teaching, technology research and development, talent training, etc., and explored a new model of innovative talent training education [4]. Shanghai University of Engineering and Technology and the local senior technical school have carried out the exploration of project-based learning and practice methods based on additive manufacturing technology and obtained corresponding teaching and research results [5]. Anhui University of Engineering has carried out research on the comprehensive ability training system of applied talent design and manufacturing for the mechanical design, manufacturing and automation of the school [6]. Shanghai Normal University applied the additive manufacturing technology to the undergraduate training course of mechanical specialty, and achieved good teaching results [7]. Meanwhile, the School of Mechanical Engineering of Xi'an Jiaotong University has applied 3D printing technology to the practical teaching of creators [8], which has stimulated students' interest and innovation ability and achieved

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good teaching results. Under the background of new engineering construction, colleges and universities attach great importance to the training of applied innovative talents, and related teaching and research reform projects have been widely carried out.

Additional material manufacturing technology has developed rapidly, and it is an effective tool to cultivate students' application and innovation ability in various colleges and universities in recent years. In view of the characteristics of the mechanical specialty of our university, various universities have carried out extensive exploration and practice of innovative talent education mode based on the added material manufacturing technology. For example, the establishment of R&D studios for added material manufacturing technology, school-enterprise co-construction of laboratories related to added material manufacturing technology. We will carry out various innovation and entrepreneurship practice activities and innovation competitions for the whole school or college students, and participate in the mechanical design and mechanical manufacturing competitions of college students at all levels. Faced with the development of the machinery industry, the rapid development of technology and the advancement of teaching methods, the exploration of the application innovation talent training model based on additive manufacturing technology needs further improvement and improvement.

3. Innovative Education Idea of Application Based on Additional Manufacturing Technology

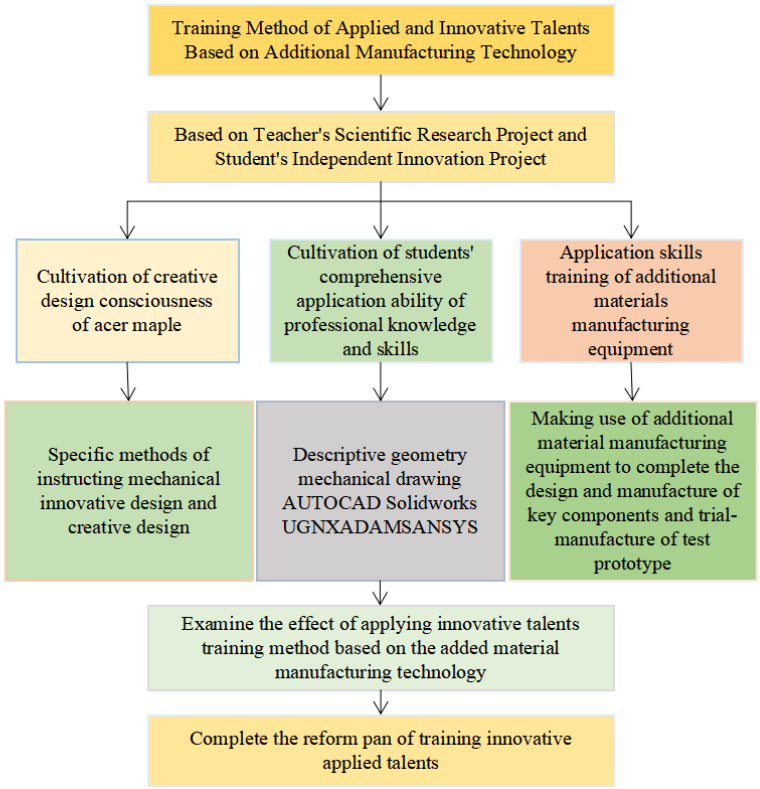

Fig.1. Project research plan roadmap

Additional material manufacturing can rapidly process more complex products in shape according to the ideas of producers or designers. The rapid manufacturing of innovative and creative products can be realized by adding material manufacturing technology, which is quite different from the traditional manufacturing industry. In June 2015, the modern digital design and Manufacturing Laboratory of mechanical design and manufacturing and Automation Specialty in Zhangjiagang Campus of Jiangsu University of Science and Technology was established. The main purpose of the laboratory is to explore and study the training methods of applied and innovative talents adapted to the development requirements of the specialty in close connection with the development trend of modern advanced manufacturing technology industry. Combine the expertise of digital design and manufacturing technology in the current professional curriculum system,

CAD/CAE/CAM software application skills and additive manufacturing equipment application skills to further improve the existing mechanical design and manufacturing and automation professionals training program. To better adapt to the needs of talents in the current machinery manufacturing industry. In the specific implementation process, discuss and form an application-innovative talent training program (Figure 1), and implement the talent training plan in accordance with the established training program.

3.1 Fostering Students' Innovative Consciousness of Mechanical Design Based on Project

Students majoring in mechanical engineering at or above the second year of the university are selected to enter the digital design and manufacturing laboratory, assign project topics to students and divide specific projects, provide students with innovative practice platform, impart specific methods of innovative mechanical design and creative design, and cultivate students' innovative consciousness of mechanical design. Constructing a model of innovative ability thinking, combining creative thinking in mechanical product industrial design with the actual functions of mechanical products in the production and application process, so that students do not stick to the existing design methods and design ideas of various mechanical products, and enhance machinery. Design innovation and creativity.

3.2 Based on the Project, the Comprehensive Application Ability of Students' Professional Knowledge and Skills should be Trained.

Instruct students to further study AutoCAD, Solidworks, ADAMS, ANSYS, UG and other engineering software on the basis of professional courses, strengthen students' use of engineering software for engineering drawing, 3D-based mechanical design, virtual prototype and finite element analysis, computer aided Comprehensive capabilities in manufacturing and other aspects to prepare for the project. On this basis, according to the previous assignment of project topics and specific project division of labor to students. In order to improve students' ability to apply professional knowledge and skills to solve practical engineering problems, the design and development of all-terrain vehicle walking mechanism, multi-legged robot walking device, mobile platform development, agricultural picking robot design and other related topics are carried out.

3.3 Fostering Students' Applied Skills of Increasing Material Manufacturing Equipment Based on Projects

The laboratory is equipped with rapid prototyping equipment such as Makeblock3D printer, Micromake parallel 3D printer, SF-3540E CNC engraving machine. Students entering the laboratory regularly participate in basic operation training arranged by technicians of additive manufacturing equipment manufacturers, familiar with the operation methods of various additive manufacturing equipment and improve application skills in actual use. After the students have the ability to operate the equipment independently, they complete the manufacturing of key parts of the self-designed test prototype, and finally complete the assembly of the test prototype, and carry out relevant experimental research based on the test prototype.

4. Practice of Training Method of Applied and Innovative Talents Based on Additional Manufacturing Technology

4.1 Creative Design and Creative Design Ability Training

Digital Design and Manufacturing Laboratory mainly provides innovative and entrepreneurial practice platform for students interested in the innovative design of additional materials manufacturing technology and machinery, as well as the working platform of innovative teaching methods for professional teachers. The operation mode of the laboratory is student-centered and guided by the instructor. After the students enter the laboratory, the teachers carry out innovative educational practice activities in a planned way. On the basis of completing the mechanical innovation design course in the talent training plan, the specific methods of mechanical innovation design and creative design are taught to enable students to understand the innovative ability

thinking model. Combine the creative thinking in the industrial design of mechanical products with the actual functions of mechanical products in the production and application process, and effectively cultivate students' awareness of mechanical design innovation.

4.2 Implementation of Scientific Research Projects Based on Additional Materials Manufacturing Technology

Since 2015, the College has selected a number of sophomores and juniors from mechanical universities to enter the laboratory. The design work has been carried out on the related topics of robot walking device design, mobile platform development and agricultural picking robots. The key components of self-designed products have been manufactured and the prototype has been built using the additional material manufacturing equipment equipped in the laboratory. In 2015, the lab students applied for the undergraduate innovation project of Suzhou Institute of Technology, Jiangsu University of Science and Technology. The dynamics of the walking mechanism of the tracked exploratory robot was simulated by ADAMS. In order to verify the correctness of the numerical simulation analysis results, the prototype of the crawler-type exploration robot was completed by 3D printer, and the test prototype was built and passed the experiment. In 2016, the laboratory students applied for and established the undergraduate innovation program of Jiangsu University of Science and Technology Jiangsu University of Science and Technology. The existing printing process of the existing 3D printers in the laboratory was out of step, the molding quality was low, the extrusion nozzles were easy to block and the body was heavier. Improvements have been made to improve the operational reliability and molding quality of 3D printing equipment.

The graduation design of laboratory students mainly comes from the sub-topics of teachers' various vertical and horizontal scientific research projects. In the course of the development of the project, the production of the prototype is also based on the existing add-on manufacturing equipment. The joint of the multi-legged robot in Figure 2 below, the body and other parts are completed through the desktop 3D printing equipment. In 2017, the laboratory students used the existing additive manufacturing equipment to make important parts of the fruit picking device. Finally, the experimental prototype was built and participated in the National College Mechanical Innovation Design Competition, and achieved excellent results. Through graduation design, various innovative entrepreneurial practice activities, and mechanical engineering design and manufacturing competitions for college students at all levels, students are fully trained. While providing students with the opportunity to prove their abilities, the practical effects of applying innovative talent training methods based on additive manufacturing technology were examined.

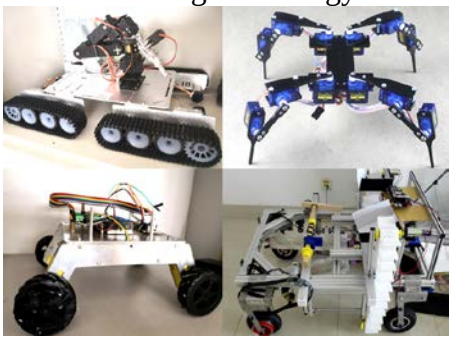

Fig.2. Various types of test prototypes based on additive manufacturing equipment

4.3 Innovative Design and Creative Design Course Development Based on Additional Manufacturing Technology

Due to the limited resources of digital design and manufacturing laboratory, it is difficult for most students of this major to participate in laboratory activities. With the support of the college and the specialty of mechanical design and manufacture and automation, the key teachers in the teaching and Research Department of mechanical manufacturing have completed the curriculum development of innovative design and creative design in the process of applying the innovative talent training method. It is planned to add innovative design and creative design courses based on

additive manufacturing technology as a professional elective course to the talent training program, which is designed for the mechanical design and manufacturing of the college and its automation and mechanical and electrical engineering. Through the curriculum, students who have a strong interest in mechanical innovation design and additive manufacturing technology can provide an in-depth learning opportunity to broaden their horizons for future career choices, while further promoting the combination of professional knowledge and professional skills to enhance students' sense of innovation. And professional ability.

5. Reflections on the Development of Applied Innovative Education Based on Additional Manufacturing Technology

Under the background of new subject construction in Colleges and universities, this research explores and forms a new training method of applied and innovative talents based on added material manufacturing technology in the process of practice, and proves the effectiveness and necessity of the combination of applied and innovative talents training methods through practice. But at present, the application innovation education implemented by our college is mainly based on the application of desktop level and small-scale additional material manufacturing equipment. It takes a long time to manufacture, and the processing accuracy is not high. It can not print metal parts with higher structural strength, which limits the realization of some innovative mechanical design ideas. With the emphasis on the development of innovative education in colleges and universities and the further investment in equipment, industrial-grade additive manufacturing equipment will be applied in the process of applying innovative talents. At the same time, the application of innovative education mode in colleges and universities also needs to go out of school, use local rich enterprise resources, carry out school-enterprise cooperation personnel training, provide students with open learning space and a broader innovation and entrepreneurship platform, and apply applications based on additive manufacturing technology. Innovative education is deep and practical.

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