

Exploration and practice of aviation manufacturing talent training mode based on "practical ability-oriented and industry-education integration"

Zheng Hu¹, Shiping Sun^{1,*}, and Lan Cheng²

¹School of Aeronautical Manufacturing Engineering, Nanchang Hangkong University, Nanchang 330063, China

²Office of Teaching Affairs, Nanchang Hangkong University, Nanchang 330063, China

Abstract. The aviation manufacturing industry is a key area for innovation-driven development. In order to adapt to the new requirements for aviation manufacturing talents put forward by the transformation and upgrading of the aviation industry, Nanchang Hangkong University and AVIC Hongdu Group continue to explore and practice the talent training channels urgently needed for tooling design positions. The university and enterprise jointly built an aviation manufacturing talent training model based on "practical ability-oriented and industry-education integration." The effective method formed from four aspects: the determination of talent training methods, the establishment of professional curriculum system, the innovation of teaching methods and the improvement of university-enterprise collaborative management mechanism. Thus, the win-win cooperation between the university and enterprise has been realized, and valuable experience has been accumulated for exploring a new aviation manufacturing talent training model.

1 Introduction

At present, under the guidance of the national policy, the integration between industry and education, as a very important work of the central and local governments and various industries, has become an important policy to promote the development of vocational education and higher education, and to strengthen the training of innovative talents and technical talents. Moreover, the integration between industry and education is an important institutional arrangement to promote the comprehensive reform of education [1]. Deepening the integration of industry and education has become the need of epoch development and social consensus [2]. In order to implement the important decision and deployment of the CPC Central Committee on "deepening the industry-education integration, school-enterprise cooperation," Jiangxi Province is taking the government as the leading force to build a high-quality integrated development platform for industry-university-research-use [3]. The construction of industry-education cooperation between aviation enterprises and

* Corresponding author: shipingsun@163.com

aviation universities aims to expand the aviation industry and strengthen aviation education, and support Jiangxi aviation's strategy of strengthening the province from the education chain, talent chain, and industrial chain.

Nanchang Hangkong University is the only aviation university in Jiangxi Province that undertakes the task of training aviation professionals, serving the aviation industry, and serving the economic development of Jiangxi. With the successful first flight of C919 in China, aviation manufacturing enterprises such as AVIC Hongdu Group have entered the stage of preparation and implementation of aircraft mass production. At this stage, a large number of advanced craft equipment and technology are put into use, and aviation enterprises urgently need aviation manufacturing talents who master advanced manufacturing technology [4-5]. In order to promote the rapid development of Jiangxi's aviation industry and serve the local economic and social development, Nanchang Hangkong University signed the "Cooperation Agreement on the Integration of Industry and Education Platform for Tooling Design" with AVIC Hongdu Group. As a major specialized in cultivating manufacturing talents in the aerospace field, the aircraft manufacturing engineering specialty [6] has actively cooperated with the Tooling Technology Center of Hongdu Group to establish an aviation manufacturing class that integrates industry and education. It aims to explore the cultivation of specialized talents for aviation tooling design and manufacturing posts, and realize the accurate supply of aviation manufacturing talents.

The aircraft manufacturing engineering specialty of Nanchang Aviation University is a brand specialty and characteristic specialty of colleges and universities in Jiangxi Province. More than 60 percent of the graduates of the major work in aviation enterprises. After nearly 20 years of development, the major has built a continuous engineering practice education system of practice, training, and practice by virtue of the university-enterprise cooperation practice education platform, which has improved the students' engineering ability. After nearly 20 years of development, the major has built an engineering practice education system integrating practice, training, and internship by virtue of the university-enterprise cooperation platform, which has improved the students' engineering ability. Nanchang Hangkong University and the tooling technology center of Hongdu Group jointly carry out the training of aviation manufacturing talents urgently needed for aviation tooling design positions. This move not only responds to the national policy requirements and implements the university-enterprise cooperation education strategy between the university and Hongdu Group, but also is an inevitable trend for the major to adapt to the development of the aviation industry, innovate the talent training mode, and enhance students' employment competitiveness. Based on the practice of integration of industry and education in the past three years, this paper discusses and summarizes from four aspects: the formulation of the talent training plan for the integration of industry and education in aviation classes, the construction of a professional curriculum system facing the needs of aviation tooling design, the development of practical teaching methods that adapt to the production environment, and the improvement of the management mechanism of university-enterprise cooperation education, which provides a reference for the school to further promote the industry-education integration and university-enterprise collaboration.

2 Formulation of talent training programs for the integration of industry and education

At present, a large number of advanced equipment and new processes integrating informatization, digitalization, and intelligent technology have been gradually put into aircraft manufacturing. The rapidly developing aviation industry urgently needs aviation manufacturing professionals. While the aviation manufacturing positions that integrate new

technologies put forward new and higher requirements for professional competence [7]. Therefore, in order to cultivate professional talents that are compatible with the needs of the industry, it is necessary to embed the talent needs of the aviation industry into the talent training process, and universities and enterprises jointly formulate professional talent training goals for positions. Through the integration of industry and education, students' job competence can be enhanced and the social fit of talent training goals can be improved.

According to the cooperation agreement signed between the university and Hongdu Aviation Industry Group, the School of Aeronautical Manufacturing Engineering and the Tooling Technology Center of Hongdu Group established the "Teaching Steering Committee of Industry-Education Integration Aviation Manufacturing Class." Combined with the development of the aviation industry and the demand for aviation manufacturing talents of Hongdu Group, a training program revision seminar attended by professional teachers, technical supervisors, and aviation experts was convened. After investigation, the university and enterprise jointly compiled an undergraduate talent training program for the integration of industry and education aviation class. With the goal of being competent for the aviation tooling design and manufacturing job requirements, graduates are required to "have good engineering practice ability in aviation tooling design and modeling. Through various practical teaching training, students can apply the knowledge and skills they have learned, and the ability to analyze and solve practical problems in complex aircraft manufacturing engineering. Therefore, the goals and requirements of the training of aviation manufacturing talents integrating industry and education were determined.

Focusing on the talent training objectives and requirements, both the school and the enterprise will put competency, professional ethics and engineering practice ability through the whole process of talent training, and jointly design the professional curriculum configuration and experimental practice content. In addition, a professional curriculum system that meets the needs of aviation tooling design and manufacturing has been built to support the talent training goal of industry-education integration.

Combined with the advantages of university-enterprise collaborative education, the teaching operation mode of the industry-education integration aviation class has been formulated. The "2.5+1.5" training model of basic knowledge learning on campus in the first 2.5 years and professional practice learning in enterprises in the last 1.5 years is adopted. This mode can give full play to the advantages of theoretical teaching and enterprise practical training in the school, thereby strengthening the combination of theory and practice of students and greatly improving their engineering practice ability. At the same time, the training model ensures the natural connection of teaching links such as subject foundation, professional courses and professional practice from the time arrangement. In addition, this model is conducive to selecting students from the third grade for university-enterprise joint training.

3 Establishment of professional curriculum system for the integration of industry and education

The curriculum is the basic unit to support the goal of talent training. Only by combining the professional curriculum with the expected job requirements of the training goals, professionals with rapid post-competence can be cultivated [8]. Focusing on the training goal of "aviation tooling design and manufacturing" in the industry-education integration aviation class, a model oriented to the development of tooling design engineering capabilities for aircraft parts forming and assembly was developed. This model combines professional theoretical courses with technical post-ability requirements to increase the proportion of practical learning hours. In addition, this model strengthens the practical ability of computer-aided engineering, and builds a professional curriculum system that

integrates industry and education from professional theory, design simulation, production practice and other links.

According to the two professional ability course groups of aircraft sheet metal and aircraft assembly, two professional course groups integrating sheet metal forming process and assembly digital application of manufacturing technology are set up. For examples: "Aircraft Sheet Metal Forming Principle," "Aircraft Parts Forming Process," "Aircraft Sheet Metal Tooling Design and Manufacturing," "Aircraft Parts Forming Simulation," "Aviation Tooling Production Skills Training," "Professional Course Design," "Professional Comprehensive Practice" to "Graduation Internship" and "Graduation Project." These courses range from theory, and practical training to comprehensive practice, thus building a curriculum system that supports the knowledge and ability of aircraft sheet metal tooling.

Based on the practical ability training of talents, each course makes full use of the production conditions of enterprises for theoretical and practical teaching. Set up experimental and practical learning hours according to the course objectives, and promote the parallel of theoretical learning and field practice, so that students can master knowledge and skills on time. For example, "Aircraft Parts Forming Simulation" allocates theoretical and practical hours according to 1:3, while "Aviation Process Equipment Production Skills Training" arranges production procedure learning and practical operation hours according to 3:1. This model can promote the cultivation of engineering practice ability. The proportion of practical hours in the industry-education integration curriculum system reached 28.2%, which provided a guarantee for achieving the goal of talent training with a solid foundation and strong practical ability.

4 Project/task-driven shaping of educational scenarios

The production tasks of Hongdu Group's tooling technology center include: tooling R&D design, analysis and improvement, trial production test and final production. These production tasks involve knowledge of the entire tooling design and manufacturing process. In addition, the technical center has rich tooling design, manufacturing and production resources, which provides a guarantee for practical teaching. However, the production tasks of the technical center are characterized by small batches and multiple types, and the main goal of the technicians is to complete the scientific research and production tasks. Therefore, in this kind of practical training that needs to complete production tasks, it is important for students to master complete professional theoretical knowledge and cultivate students' engineering practical ability. It involves how to form practical solutions to engineering problems in theoretical teaching, and comprehend the application of professional theories in production practice, which require teachers to design a teaching process carefully. Moreover, students have different professional knowledge points due to the different engineering tasks completed during the practice stage. Therefore, how to assess the professional courses decomposed into task practice and how to evaluate the acquisition of students' engineering practice ability, we need to establish a scientific and reasonable quality evaluation system to ensure the quality of teaching, so as to ensure the quality of education.

According to the division of production tasks of each department of the tooling technology center, a model with project/task as the main line is proposed. By sorting out professional theoretical knowledge and production practice content, the systematic professional theoretical knowledge is fragmented and modularized. And disperse the above content into the production practice tasks, and guide students in practice with professional knowledge. Professional knowledge is used to guide students in practice, and students apply professional theories in practice. Promote professional ability training with enterprise

production tasks and strengthen problem-driven learning and practice. Therefore, this model can quickly cultivate students' engineering practice ability, thereby constructing a new teaching method and scenario for teacher teaching and student learning. Take a project/task completed by a student as an example, as shown in Fig. 1. The task was to design a tooling for the cutting edge of the aircraft skin. In the design scheme, the vacuum absorption method is selected to fix the aircraft skin, and high stiffness and lightweight curved platform is used to support and position the aircraft skin. The following tasks need to be completed according to the actual skin material properties, appearance characteristics and trimming process: overall design of tooling platform, vacuum adsorption scheme planning and calculation, connection method between platform and adsorption fixture, etc. The whole task process involves the content knowledge of many professional courses, such as "Aircraft Sheet Metal Forming Principle," "Aircraft Parts Forming Process," "Aircraft Sheet Metal Tooling Design and Manufacturing," "Aviation Manufacturing Technology and Application," "CATIA Modeling and Application," "Aircraft Assembly Simulation" and so on, which belong to the nature of professional course design. The traditional "professional course design" is carried out after the student has completed the professional course. However, the integration of industry and education is to use professional production tasks to guide and drive students to take the initiative to learn, learn while applying, and cultivate students' ability to solve complex engineering problems in the process of completing projects/tasks.

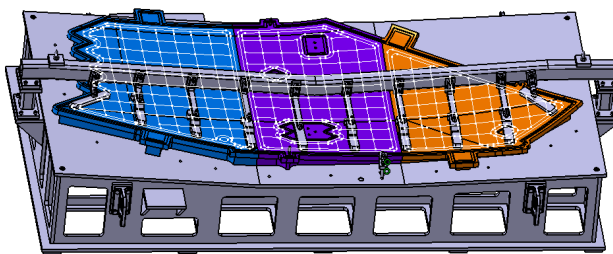


Fig. 1. A tooling for the cutting edge of the aircraft skin.

Combined with the diversity of students' practical tasks, the university and enterprise jointly formulated the following assessment methods: use the process performance of completing projects/tasks to assess students' professional quality; Assess the mastery of modular knowledge with the completion of projects/tasks; Fragmented expertise strung together with project/task summary reports; Use project/task reporting defense to test job competency. By shaping project/task-driven professional education scenarios, students can complete learning effectiveness checks and course assessments.

5 Formation of a standardized management mechanism for university-enterprise collaborative education

The industry-education integration and education and university-enterprise cooperation are order-based talent training models that adapt to social and economic development and solve the urgent needs of enterprise positions. By introducing enterprises into the supply side of talent training, we can use the enterprise's on-site practical teaching resources to cultivate professionals who meet the needs of enterprises. In this way, the pertinence and competitiveness of talent training can be improved, and the "supply and demand" coordination of talents can be achieved [9]. However, in the process of talent cultivation in the integration of industry and education, due to the great differences in the objects of concern and management mechanisms between universities and enterprises, the enthusiasm

of universities and enterprises for educating students is different [10]. Therefore, in order to successfully realize the integration of industry and education in the cultivation of innovative talents, it is necessary to establish a set of talent training management mechanisms based on practical education consensus. Moreover, from the aspects of management institutions, teaching operation management, student and teacher management, teaching quality evaluation and guarantee, etc., to ensure the training quality of industry-education integration engineering application talents.

According to the strategic cooperation agreement signed between the Nanchang Hangkong University and AVIC Hongdu Group, the teaching steering committee of the industry-education integration aviation manufacturing class was established, including the chief teacher of the tooling technology center, the training director, the teaching dean of the college, and the professional leader. In addition, the charter document for the teaching management of the industry-education integration aviation manufacturing class has been formulated. The aircraft manufacturing engineering specialty has established a teaching management group headed by the department leader, which standardizes the management methods of student selection and class formation, curriculum teaching arrangement, and teaching quality assessment; The tooling technology center has set up a practical teaching group headed by the training leader and composed of the heads of various departments, which conducts practical content arrangement, leading teacher management and student practice site teaching management; The department leader and the training leader negotiate the process supervision and task adjustment of teaching. Focusing on the training goals of aviation manufacturing talents, the two sides clarified their respective management responsibilities and formed a standardized management mechanism for university-enterprise collaborative education, as shown in Fig.2.

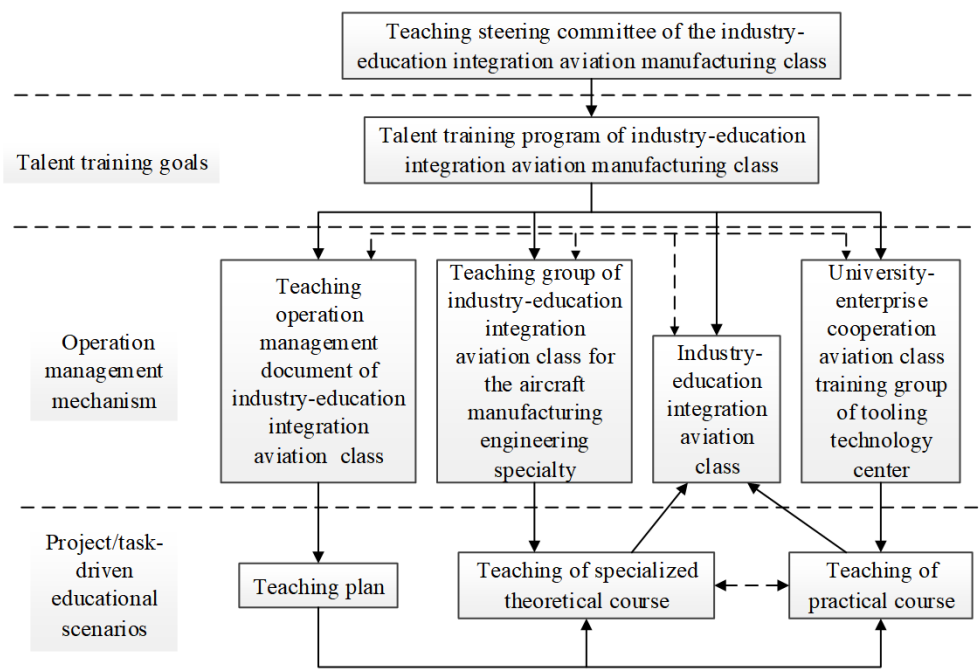


Fig. 2. Block diagram of the management mechanism of school-enterprise collaborative education.

6 Conclusions

Focusing on the new requirements for aviation manufacturing talents put forward by the transformation and upgrading of the aviation manufacturing industry, and taking the initiative to meet the urgent needs of AVIC Hongdu Group's manufacturing positions, we have carried out the exploration and practice of aviation tooling design and manufacturing talent training integrating industry and education with the tooling technology center of Hongdu Group. In addition, a set of methods has been formed that can be continued and promoted. The graduates of the two previous aviation classes integrating industry and education are all employed in aviation companies, which has improved the school's ability to serve national defense aviation and local economic construction, and highlighted the school's aviation characteristics.

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