Reflections and Analysis on the Development of the Smart Textbook for "Aircraft Performance Engineering"

Haiping Li, Yonghu Wang* and Chengcheng Duan

School of Aeronautics, Chongqing Jiaotong University, Chongqing, 400074, China

*wangyonghu@cqjtu.edu.cn

Abstract

Intelligent teaching textbooks represent a comprehensive upgrade of traditional teaching materials in terms of concept and technology. They are a new form of teaching materials at the forefront of teaching materials construction, and play an important role in the development of China's higher education in the new era. The construction of intelligent teaching materials for the Aircraft Performance course is of primary importance and provides critical support for the course development. This paper analyzes the necessity of constructing intelligent teaching textbooks based on the problems of existing teaching materials. The construction of smart textbooks for Aircraft Performance Engineering is guided by the concept of big textbooks and based on existing textbooks. It integrates modern education concepts and information/intelligent technology and is based on the training program for applied talents. The construction of intelligent textbooks for Aircraft Performance Engineering is mainly approached from four key aspects: textbook system, textbook content, textbook resources, and teaching platform.

Keywords

Intelligent teaching textbooks, Aircraft Performance course, Big textbooks, Teaching platform.

1. Introduction

The textbook is the foundation of the course and the fundamental guarantee for the implementation of the course. Smart textbooks generally refer to comprehensive course support environments that are built on traditional print textbooks, integrating modern educational concepts and information/intelligent technology, as well as multiple forms, levels, and purposeful teaching resources. In terms of content, the emphasis is on the combination of professionalism and ideological and political education, theory and practice, highlighting the guiding role of ideological values and the developmental nature of knowledge transformation into wisdom. In terms of form and usage, the focus is on upgrading from a single form to a three-dimensional one, emphasizing the diversity of forms, intelligent means, and adaptability of the environment.

In course construction, the textbook should be given priority. The first step in developing a key course is to construct high-quality teaching materials, and intelligent teaching materials represent high-quality teaching materials, incorporating new ideas and technologies, and embodying a new form of teaching materials. How to solve the problems of existing teaching materials under the guidance of new ideas and technologies, and develop intelligent teaching materials that meet the requirements of aviation application-oriented talent training for the western region, has become the primary issue to be addressed.

Aircraft Performance Engineering is a comprehensive and multidisciplinary aviation engineering course that encompasses aviation airworthiness, civil aviation operations, engine

performance, aerodynamics, flight mechanics, flight performance, and aviation safety. It focuses on the training of technical personnel in both transport aviation and general aviation maintenance engineering, emphasizing qualities such as innovative consciousness, entrepreneurship, participation consciousness, critical thinking ability, and the ability to solve major problems independently.

Considering the employment opportunities available to aviation professionals, the course not only covers aircraft performance related regulations such as CCAR25, CCAR121, and CCAR23, but also includes CCAR27, CCAR29 for helicopters, and UAV systems. This will help students with their employment direction in transport aviation, general aviation, and aviation-related departments of the Ministry of Transport, while also highlighting the specialty and practicality of the course material and students' innovation ability.

The development of high-quality textbooks for aviation-related majors is an important area of research, particularly in the new era, as it is crucial for advancing the aviation industry and enhancing the quality and competence of aviation professionals. Therefore, the aim of this study is to explore the construction of high-quality textbooks for aviation-related majors and to improve their effectiveness and practicality through practical application, in order to meet the needs of contemporary aviation education in China.

2. Feasibility Analysis

Civil aviation is an important strategic industry for China's economic and social development. Efforts should be made to strengthen the construction of scientific and technological talents and bases, promote scientific and technological innovation in civil aviation enterprises, enhance the transformation and application of scientific and technological achievements, and accelerate the improvement of the civil aviation public service and consumption capabilities. According to the "Thirteenth Five-Year Plan for Civil Aviation Education and Training," the civil aviation industry must prioritize human resources as the primary resource for development in order to enhance its continuous safety assurance capability, achieve quality improvement and efficiency enhancement, transform and upgrade, and strengthen international competitiveness.

As an important strategic support point for the Western Development, Chongqing plays a crucial role in the national regional development and opening-up under the framework of "the Belt and Road Initiative" and the Yangtze River Economic Belt. Currently, Chongqing is accelerating the layout of the aviation industry and vigorously developing the aviation industry cluster, in accordance with the positioning of "two points", "two cities", "two highs" proposed by General Secretary Xi Jinping for the development of Chongqing, as well as the requirements of "solidly promoting" in various aspects. Chongqing is also striving to implement the action plans for promoting the development through science and education and strengthening the city with talents. In 2017, the "Three-Year Action Plan for the Development of General Aviation Industry in Chongqing (2017-2019)" and the "Opinions of the General Office of Chongqing Municipal People's Government on Accelerating the Construction of International Aviation Hubs and Promoting the Comprehensive Development of Civil Aviation Industry" were released. The aviation program, based in the western region and serving nationwide related enterprises and research institutions, focuses on aviation and astronautical science and technology and engineering applications. It prioritizes the manufacturing of general aviation aircraft, design and manufacturing of general aviation engines, and maintenance and repair of civil aviation aircraft and engines. The program aims to serve the economic and social development of the country and regions and build itself into an advantageous specialty with distinctive aviation features.

The course of Aircraft Performance Engineering is a core course in the professional background of aircraft power engineering talent cultivation. In the new version of the talent training

program, the positioning and content system of the course have been redefined and upgraded. Meanwhile, this course has been added to the training process of aviation-related master's degree programs. Therefore, the course construction urgently needs a high starting point, longterm goal design, in-depth integration of new ideas, new concepts, and new technologies, in order to complete the task of new textbook construction with high quality and standards.

3. Analysis of Existing Problems

Currently, to meet the urgent need for textbooks in the characteristic disciplines of the aviation academy and to address the issue of teaching materials gaps in some subject areas, a combination of introduction of textbooks and selection of textbooks by instructors is the only viable solution. However, it is evident that it is almost impossible to find textbooks that meet the objectives of educating aviation talents in the new era and professional development, as well as conforming to the requirements of the Ministry of Education's "New Engineering" era. Moreover, aviation-related majors are unique and characterized by strong professional relevance, and some published textbooks are outdated, making it challenging to achieve targeted and unified professional and general education. Therefore, the current adoption of professional textbooks generally lacks the concepts required by the "New Engineering" era, and there are deficiencies in guiding students to pursue true knowledge and practical abilities, as well as insufficient development in quality cultivation and course content.

To cultivate the spirit of craftsmanship among aviation professionals, it is necessary not only to utilize the role of ideological and political education in the cultivation of this spirit, but also to incorporate it into the teaching of both theoretical and practical courses. Currently used professional textbooks fail to fully embody this spirit, and do not comprehensively and accurately expound upon the advanced theories and concepts of the subject, nor the interrelationships and developmental patterns among its various knowledge points. Therefore, innovative and distinctive professional course materials in aviation entrepreneurship should be prioritized.

The construction of teaching materials through university-enterprise cooperation is an important requirement for the construction of applied undergraduate programs under the national program of industry-education integration development. The significant characteristic of this model is that it combines theory with practice and adapts to the constantly evolving demands of the aviation industry. However, the current selection of teaching materials has difficulty fully addressing the issue of balancing theory and practice, and lacks guidance from relevant technical personnel from enterprises during the development process. As a result, there is a deviation between the development ideas of university-enterprise cooperation and the actual needs, and the talent trained may not meet the demands of the new era aviation enterprises, especially in terms of order-based talent training.

Although textbooks nowadays come in various forms, they lack dynamism, imagery, situational context, and novelty. This often results in a lack of sustainability in online teaching and network resource construction, making it difficult to reflect the characteristics of student-centered, active, interactive, and personalized learning. Therefore, it is necessary to fully utilize modern educational technology, methods, and means to achieve online teaching functions and build modern smart classrooms and smart textbooks.

4. Problem Solving Methods

To create high-quality and professional textbooks, the textbook writing team must adopt a construction idea that is not only innovative but also explores new paths for constructing professional textbooks that align with the new era and college-level standards. The goal is to build benchmark professional textbooks that will lay a solid foundation for the construction of

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disciplines and other textbooks. The key is to strengthen the teaching level of professional courses by improving the quality of student training, promoting teacher-student interaction, and guiding students towards seeking truth, acquiring knowledge, and practicing skills. By incorporating case analysis and practical application links, students can learn and gain practical skills, which reflects the connotation construction and quality improvement in each student's learning outcomes.

For example, in Chapter 2, which covers the topic of Aircraft Takeoff Performance, the textbook should establish performance calculations that meet the requirements of airworthiness and operational regulations, including solving for takeoff speed (V1/VR/V2), takeoff distance, and maximum takeoff weight. The textbook should also provide practical application tools such as takeoff analysis tables for Boeing and Airbus aircraft models widely used by airlines. By adopting this approach, students will be actively engaged in learning and will have a better understanding of the subject matter. Additionally, the materials will help students gain practical knowledge that can be applied in real-world situations, enabling them to excel in their future profession.

In order to fully convey the importance of ideological and political education, the textbook should emphasize that aviation talents are not only professionals with technical expertise and business acumen but also have an understanding and appreciation for the values of aviation power. By integrating these values into the professional courses, teachers can bridge the gap between teaching and education and ensure that students can enhance their professional abilities while cultivating their overall values.

For example, in the first chapter, the textbook should place emphasis on the importance of becoming a strong aviation country through the students' aspirations as professionals in the aviation industry. Additionally, a new reading material can be added to Chapter 6 (Aircraft Landing Performance) that highlights the heroic efforts of Captain Liu. In 2018, he piloted a Chongqing Airlines Airbus A320 aircraft that experienced an accident over Chengdu and successfully conducted a forced landing at Chengdu Shuangliu Airport. The reading material will support the underlying theme of the textbook that not only does the aviation industry require professionals with technical ability but also those individuals who embody the values of aviation power, such as problem-solving, adaptability and courage.

To enhance the collaboration between schools and enterprises and ensure the practicality of learning, we must integrate curriculums, learn from successful school-enterprise cooperation models, and introduce the concept of large aircraft teaching to vigorously promote "schoolenterprise integration."

For instance, to ensure a practical and relevant curriculum, the writing team should collaborate with industry partners. This collaboration acknowledges that school-enterprise partnerships are essential to creating high-quality textbooks. The writing team should consider aircraft performance content at various stages of flight and incorporate them into the aircraft flight profile. Performance engineers from the flight operation center AOC at Chongqing Airlines and Western Airlines can participate in the development of the materials and offer real-world case studies that can elevate the quality of the textbooks.

Moreover, the inclusion of aircraft performance engineering cases that have been in actual airline operations can further enhance the quality of the high-quality textbooks. In this way, the curriculum will be applicable to industry standards and trends, providing students with practical knowledge that they can apply directly to their future careers.

By merging classroom theory with practical experience, we can ensure that students have the necessary skills to thrive in their respective careers. Ultimately, this approach will significantly benefit the aviation industry and provide students with a comprehensive education experience necessary to excel.

When constructing teaching materials, we should take full advantage of the offline teaching resources available to us. By deeply integrating information technology with education and teaching, we can promote the construction of online resources, implementing novel interactive teaching methods through the internet. In this way, we can renew our professional teaching concepts, expand our teaching resources, innovate teaching modes, and reform learning methods. Ultimately, this will ensure that we fully complete the teaching task, increase teaching efficiency, enhance the learning effect, and guarantee that the quality of online learning and offline classroom teaching is equivalent.

For example, we can create a cutting-edge micro-class on aviation accident analysis in the form of video, PPT, PDF, and other multimedia formats. Students are able to watch and ask questions in real-time, and receive immediate feedback. Alternatively, students can create their own animations or videos to demonstrate their ideas, continuously updating the online resource base.

By harnessing the power of information technology to supplement and enhance our teaching methodologies, we can expand our curriculum beyond the confines of typical classroom settings. The resulting integration of online and offline teaching resources will lead to a deeper understanding of aviation-related issues and a more comprehensive educational experience for students.

5. Conclusion

The creation of intelligent teaching materials for Aircraft Performance Engineering is founded on the principles of school-enterprise collaboration, the integration of modern educational concepts, and the utilization of information and intelligent technology. This paradigm shift breaks with traditional teaching materials construction methods, providing a comprehensive solution to intelligent teaching materials development across all aspects.

This groundbreaking project will not only provide extensive support for the design of aircraft performance engineering curricula but will also serve as a reference for related courses. Its greatest potential may lie in the creation of intelligent teaching materials for postgraduate courses, where the project's novel approach can be further refined and reimagined.

Ultimately, the development of intelligent teaching materials for Aircraft Performance Engineering represents a fundamental stage in the promotion of modernized, practical education that increases students' knowledge and skill levels while simultaneously preparing them for the real-world problems they will encounter within the aviation industry.

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