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Reform and Practice of Aerodynamics and Principles of Flight Assessment Mode

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Abstracts: Aerodynamic theory provides a solid theoretical foundation for the design, performance optimization, and flight control of aircraft, and the aerodynamic performance of aircraft is directly related to its safety, economy, so it is crucial for the sustainable development of the aviation field. This paper discusses the reform program of the assessment mode of aerodynamics and flight principles, aiming to make it more in line with the demand for professional talents in the modern aviation field. Through an in-depth study of the key position of aerodynamics in the field of aviation and the significance of the assessment mode for the training of professional talents, an innovative assessment program is proposed to better meet the challenges and needs of future talent training in the field of aerodynamics and principles of flight to cultivate more excellent aviation professionals.

Keywords: aerodynamics; principle of flight; assessment; mode reform

Introduction

The assessment mode is important in cultivating professionals in the field of aerodynamics and principles of flight, and the traditional assessment mode is often limited to the testing of theoretical knowledge and simple skills, which makes it difficult to comprehensively assess the students' ability to cope with the complex flight environment. To better cultivate professionals who can adapt to the challenges of the aviation field, the assessment mode must be in line with the needs of the industry and focus on the cultivation of student's practical skills, teamwork and innovation.

1. The Current Situation of the Assessment Mode of Aerodynamics and Flight Principles

1.1 Analysis of the advantages and disadvantages of the traditional assessment mode

In the field of aerodynamics and flight principle assessment, the traditional assessment mode is based on the traditional written test, flight simulation, and actual flight assessment, and its advantages and disadvantages present a series of characteristics in the current practical application. The advantage of the traditional assessment mode lies in its relatively simple and intuitive implementation, through the standardized written test and flight simulation, it can carry out a preliminary assessment of the students' theoretical knowledge and operational skills, which provides a basic quantitative means for the training of pilots, and this mode is relatively easy to organize, and it also conforms to the relatively rudimentary training conditions in the past (Wu et al., 2022). However, there are a series of obvious defects in the traditional assessment mode, the first of which is that its assessment of the comprehensive quality of students is relatively one-sided; the traditional written test makes it difficult to comprehensively examine the students' resilience to complex flight environments and practical operational skills, and the flight simulation merely simulates the real flight environment and lacks the experience of responding to emergencies in real flights (Han, 2020). In addition, the traditional assessment mode ignores individual differences and cannot fully meet the individualized learning needs of students, while the

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actual work of pilots needs to emphasize the individual's innovative ability and adaptability. In the face of these challenges, some colleges in China have begun to explore the use of advanced assessment means, such as actual flight simulators and comprehensive practical programs, to more comprehensively assess the comprehensive quality of students, this new assessment mode is more in line with the actual work requirements of aerodynamics and flight principles and can better cultivate pilots with innovative thinking and practical skills, and improve their actual flight coping ability in the actual flight.

1.2 Motivation and objectives of assessment mode reform

The motivation for the reform of the assessment mode stems from the recognition of the limitations of the traditional assessment mode and the continuous change of the training needs of pilots. With the continuous development of flight technology and aircraft design, the traditional written test and simple flight simulation can no longer comprehensively assess the students' ability to cope with complex aerodynamic environments, and the traditional assessment mode lacks the degree of restoration of the real environment and is unable to effectively simulate the complex situations faced by the pilots in the actual operation, which is very important in the development of the flight technology and the aircraft design. The traditional assessment mode lacks the reproducibility of the real environment and cannot effectively simulate the complex situation faced by the pilots in the actual operation, which to a certain extent hinders the students' ability to apply in the actual flight (Chen et al., 2021). Secondly, modern pilots need more comprehensive qualities, including the ability to adapt to innovative technologies, the sense of teamwork, and the ability to make real-time decisions in complex flight environments. The traditional assessment model tends to focus too much on theoretical knowledge and fixed operational skills, while neglecting the cultivation of these aspects, leading to the dilemma of dealing with the challenges that students may face in actual flight. Therefore, the goal of the assessment mode reform is to establish an assessment system that is more in line with practical needs, more challenging, and realistic. The new assessment mode aims to enable students to train and assess in a more realistic and richer flight environment through the introduction of virtual reality technology, actual flight simulators, and comprehensive hands-on programs so that their understanding and application of complex aerodynamic principles can be comprehensively enhanced. This reform is imperative to ensure that more practical ability and innovative pilots are trained to adapt to the continuous development and challenges of the future aviation field.

2. Key Strategies of Assessment Mode Reform

2.1 Introduction of the actual flight simulator

The introduction of actual flight simulators is an important initiative. Actual flight simulators can not only improve pilots' operational skills but also assess their understanding and application of aerodynamic principles in a more realistic environment. Taking the comprehensive assessment of real flight simulators as an example, the assessment can be designed to include a series of simulated flight tasks that include complex meteorological conditions, emergency simulation, and multi-aircraft co-operation, which should cover different aircraft types to ensure the comprehensiveness and diversity of the assessment. Focusing on students' real-time decision-making ability in the flight simulation, the students' emergency response can be assessed by introducing unexpected situations (e.g., engine failures, sudden changes in airflow, etc.), which can effectively examine the students' adaptability and decision-making level in the complex flight environment. At the same time, an actual flight simulator can be utilized to conduct a comprehensive assessment of the pilot's operation of the aircraft system during the flight process, including takeoff, landing, and in-flight status adjustment, etc., which can help to cultivate the student's ability to apply the principles of aerodynamics in actual operation. In addition, a series of comprehensive tasks can be

designed to require students to perform comprehensive operations such as route planning, flight plan adjustment, navigation, and communication in simulated flights to comprehensively assess their ability to work in real scenarios. In the assessment, the parameters of the simulated environment, such as airflow strength and weather conditions, are adjusted to simulate different flight environments and verify the student's ability to cope with aerodynamics in various situations. The introduction of actual flight simulators in this examination program can be more in line with the actual working needs of pilots so that they can obtain more realistic and comprehensive flight experience in a safe environment, and improve their ability to combine theory and practice of aerodynamics and flight principles.

2.2 Strengthen the experimental course design

The experimental course design can emphasize the combination of theoretical knowledge and practical skills by simulating the real flight environment and providing students with opportunities for practical operation in the laboratory. Taking the aerodynamics experimental course design as an example, the assessment can formulate a series of aerodynamics experimental tasks covering key concepts such as vehicle aerodynamics, lift and drag, stability and maneuverability, etc. The experimental tasks should be combined with different types of vehicles to ensure the student's understanding of the diverse scenarios. The wind tunnel is then used to conduct aerodynamic experiments to examine the effects of different wing shapes, fuselage designs, etc. on flight performance. Through actual measurements and data analysis, students can gain a deeper understanding of the application of aerodynamic principles in aircraft design. Secondly, the experiment is combined with flight simulation to design the aerodynamic problems that may be encountered during the actual flight, and students verify the practical application of theoretical knowledge by maneuvering the aircraft and adjusting the parameters in the simulated environment. In addition, the assessment also emphasizes students' ability to collect and analyze experimental data. Through the use of advanced data collection equipment, students can obtain accurate data on key parameters in the experiment and evaluate the performance of the vehicle through analysis. Students are required to complete a detailed experimental report, including experimental design, data analysis, conclusions, and suggestions for future improvement, which helps to develop students' scientific research ability and practical problem-solving ability.

2.3 Conducting teamwork projects

Conducting teamwork projects is a highly prospective and practical measure, which is a strategy aimed at cultivating students' teamwork, leadership, and practical problem-solving abilities, which is in line with the demand for multidimensional qualities in the modern aviation field (Guo et al., 2019). Take the teamwork project "New Aircraft Design and Simulation" as an example, students will be grouped into interdisciplinary teams, including aerodynamics majors, aircraft design majors, control engineering majors, etc., simulating the real engineering teamwork mode. Each team is responsible for the design of a new type of aircraft and is required to consider the application of aerodynamic principles in the design, such as the shape of the wing, the power system, the control system, and so on. The design proposal needs to contain a detailed theoretical basis and engineering realization scheme. In this project, a flight simulator can be used to simulate and test the new vehicle designed by each team. By setting up a variety of flight environments and missions, the performance of the vehicle designed by the team can be examined under different conditions, with an emphasis on evaluating its aerodynamic characteristics. During the simulated flight tests, the teams were required to make adjustments and improvements to their designs based on real-time feedback, which not only tested the student's theoretical knowledge of aerodynamics but also emphasized the team's ability to collaborate in problem-solving and continuous improvement. In the end, each team is required to submit a detailed

and comprehensive report including the design concept, simulated flight test results, improvement plans, and summaries, and is also required to conduct a demonstration to show the performance of the new vehicle they have designed in the simulated flight. Through this assessment program, students will learn how to apply aerodynamic principles to actual aircraft design in teamwork, and experience and evaluate the performance of the design realistically through simulated flight tests, which will help to cultivate students' teamwork spirit, practical problem-solving ability, and better adapt to the future needs of complex aviation fieldwork.

2.4 Interdisciplinary knowledge integration

Under the framework of interdisciplinary knowledge integration, students will not only learn the basic theories of aerodynamics and flight principles but also need to get involved in related disciplinary fields, such as control engineering, materials science, aerospace engineering, etc. This comprehensive disciplinary integration can better cultivate students' interdisciplinary thinking and problem-solving abilities so that they can understand and apply the knowledge of aerodynamics and flight principles in a more comprehensive way (Li, 2018). The key to interdisciplinary knowledge integration lies in integrating knowledge from related disciplines into the study of aerodynamics and flight principles through instructional design and curriculum. This includes organizing interdisciplinary lectures, introducing interdisciplinary project practice, and organizing interdisciplinary teamwork and other forms, through which students will not only be experts in the field of aerodynamics and flight principles but also have comprehensive qualities in a wider range of subject areas. The strategy of interdisciplinary knowledge integration helps to cultivate a more comprehensive literacy in students, enabling them to better understand and cope with the challenges of the modern aviation field, which is also in line with the current trend of increasing emphasis-on multifaceted qualities in the demand for pilots and aerodynamics professionals in the aviation field.

3. Implementation and Effectiveness Evaluation of Reform Programs

3.1 Adjustment of teaching system

The adjustment of the teaching system is an important link to ensure the smooth progress of the reform and achieve practical results, which are aimed at improving the quality of teaching, adapting to the modern needs of the aviation field, and better meeting the requirements of students' comprehensive quality training. Firstly, the adjustment of the teaching system includes updating the teaching content and methods, introducing the latest scientific research results, technological advances, and actual cases, making the teaching content more in line with the development of the industry, and adopting diversified teaching methods, such as case study, group discussion, project practice, etc., to stimulate the interest of students in learning, and to improve their practical skills and teamwork ability. Secondly, the adjustment of the teaching system needs to focus on interdisciplinary integration, integrating related disciplines into the traditional teaching of aerodynamics and flight principles, so that students can understand and apply aerodynamic principles more comprehensively, establishing a multidisciplinary cooperative teaching team, and promoting the communication and cooperation of professionals in different disciplinary fields to promote the integration of knowledge (Jiang et al., 2015). In addition, for the introduction of innovative teaching methods such as actual flight simulators and teamwork projects, training and upgrading of the faculty are needed. Teachers need to be equipped with advanced teaching concepts and techniques and be able to flexibly use new technological means to guide students in actual flight simulation and interdisciplinary projects to ensure that the teaching process is both scientific and rational as well as creative. In the implementation stage, the actual effect of the reform program is comprehensively evaluated through multi-dimensional indicators such as student performance, course grades, actual flight simulation tests, and team project results, and at the same time, student feedback and expert evaluation

are used to collect the opinions of different subjects to provide a scientific basis for further adjusting and optimizing the teaching system. Through the reasonable adjustment of the teaching system, students can be better motivated to deeply understand the theoretical knowledge of aerodynamics and the principle of flight, improve their practical ability and teamwork ability, to better meet the needs of China's aerodynamics and principles of flight in the field of personnel training

3.2 Establishment of student evaluation and feedback mechanism

In the implementation and effect assessment of the assessment mode reform program, the establishment of a student evaluation and feedback mechanism is designed to fully listen to students' voices and understand their learning experience, needs, and expectations, to adjust and optimize the teaching program in time. To establish a student evaluation and feedback mechanism, an anonymous questionnaire or an online feedback system can be designed, where students can freely express their feelings about the new teaching mode, their level of understanding of the teaching content, and their views on the assessment methods. The content covered by the questionnaire can include the effectiveness of the teaching methods, the practicality of the course content, and the experience of the actual flight simulator and teamwork program, to comprehensively understand the students' attitudes and perceptions of the teaching reform (Huang et al., 2017). Student representatives can also be invited to exchange opinions in depth through regular symposiums or focus group discussions, which is a more direct form and helps to gain a deeper understanding of the specific feelings and suggestions of students, and also provides teachers with more specific suggestions for improvement. Through face-to-face interaction with students, we can get a more comprehensive picture of their attitudes toward the new assessment model, and we can also answer their concerns promptly. At the same time, a special feedback channel for students can be set up to encourage them to put forward their suggestions and questions at any time through emails, online forums, etc. A timely communication mechanism can be established so that students can give direct feedback to teachers when they encounter difficulties or dissatisfaction, and get timely responses and solutions. Finally, the mechanism of student evaluation and feedback not only helps to collect opinions, but also needs to establish a perfect closed loop of feedback. Teachers should summarize and analyze students' feedback in time, make appropriate adjustments according to the needs, and feedback on the improved solutions to students to form a continuous optimization cycle. Through the establishment of a student evaluation and feedback mechanism, a more comprehensive and in-depth understanding of the acceptance and assessment of the effect of the reform of the assessment mode can be achieved, which will help to improve the quality of teaching from the perspective of the students and ensure that the reform program can better meet the needs and expectations of the students.

3.3 Monitoring of graduate employment

The monitoring of graduate employment is a key assessment indicator. This monitoring aims to gain an in-depth understanding of the actual impact of the reformed teaching quality on graduates' competitiveness in employment and career development, to evaluate the effectiveness of the assessment model more thoroughly. Firstly, a sound database of graduates' employment situations is set up to collect graduates' employment information, including employment companies, positions, salary levels, etc., through establishing close cooperation with enterprises, airlines, and other industry organizations. This database not only helps monitor the overall employment situation of graduates but also provides in-depth industry insights that can serve as a reference for further optimization of the teaching program. Secondly, regular graduate tracking surveys are conducted to keep in touch with graduates through phone calls and emails for some time after graduation to understand their actual performance and career development in the workplace; such surveys not only capture the

experience of graduates in the early stages of their careers but also identify the impact of the reformed teaching model, providing feedback for timely adjustments and improvements (Han, 2020). At the same time, a joint research and cooperation mechanism with enterprises in the aviation industry is established to understand the skills and qualities required by graduates in actual work through in-depth communication with employers, and this two-way information exchange helps to make a more accurate assessment of the actual effects of the teaching program and provide guidance for further reform. Finally, data such as employment rate and career development trajectory of graduates are analyzed to assess the effectiveness of the reform program from a comprehensive perspective. The employment situation of graduates is not only a visual reflection of the effectiveness of the teaching mode, but also an important indicator to test the quality of teaching, and through the in-depth analysis of the employment data, the problems in the teaching program can be found and reasonable suggestions for improvement can be provided.

Summarize

To summarize, the innovation of the assessment mode is not only to respond to the current needs of the aviation field but also to cultivate students' more comprehensive and competitive professionalism. Through the introduction of innovative teaching methods such as actual flight simulators and teamwork projects, as well as the implementation of strategies such as interdisciplinary knowledge integration and the adjustment of the teaching system, we can cultivate students with more comprehensive qualities while injecting new vitality into the development of the aviation field. This is not only a deep understanding of aerodynamics and flight principles, but also a continuous contribution to the future of aviation, laying a solid foundation for the prosperity and innovation of aviation.

Conflict of Interest

The authors declare that they have no conflicts of interest to this work.

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