Chapter 3
Blending Conventional Methods with Emerging Flight Simulation Technology as Tools for Effective Teaching and Learning Experiences in Aerospace Engineering

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ABSTRACT

Engineering is about wealth creation for the comfort and well-being of human beings. In this context, the process and experiences associated with teaching and learning of engineering concepts are pivotal in sustaining and advancing the progress of modern day civilization. However, the teaching of aerospace engineering is not easy and fraught with difficulties, as the students have to be provided with the opportunity to develop their creative skills while retaining a professional and practical base. It is also important to proactively harness the available and emerging technologies to greater effect in the learning process. At the University of New South Wales in Australia, the authors have approached the teaching and learning in undergraduate aerospace engineering from a non-conventional perspective to prepare students to be creative and become practically oriented for productive employment in the very competitive world of today. They have been experimenting and refining what is generally known as the "advanced project design study concept" used in some aerospace industries and incorporated it as an integral component in aerospace engineering studies. In the process, the authors have blended conventional methods with flight simulation as methods of enquiry and investigation. The feedback, support, and encouragement that they have received from industries, the potential employers of students, have been very positive. This chapter outlines the basic philosophies behind the authors' approach and the methodologies and technologies used in achieving the desired outcomes.

DOI: 10.4018/978-1-4666-5011-4.ch003

INTRODUCTION

Progress in aerospace science and engineering has moved at such a rapid pace in the last few decades that the task of teaching aerospace engineering keeping abreast with such developments at the tertiary level has become ever more challenging. Aerospace Engineering is concerned with the design, development, construction, testing and manufacture of aircraft and aerospace vehicles, the maintenance and operation of aircraft, and research in related areas. Thus the activities associated with Aerospace Engineering are extensive. They cover the design of aircraft, the use of computer based finite element and computational fluid dynamics analysis, the planning of aircraft purchases for specific roles, the operation of aircraft, the organisation of the manufacture of aircraft and their components and the monitoring of the airworthiness of aircraft.

At the University of New South Wales, we pride ourselves as being a research intensive educational institution. There is a heavy emphasis on preparing students during their tertiary education for both advanced research (Ahmed, 2012, Ahmed, 2012) leading to PhD degrees in aerospace and related disciplines as well as being employment-ready immediately after completion of their Bachelor of Engineering degree. The present chapter is built around the teaching and learning methodologies employed for aerospace engineering studies at the tertiary level at the University of New South Wales with a particular focus on being able to design an aerospace vehicle. Aerospace Engineering is one of the five programs offered by the School of Mechanical and Manufacturing Engineering at the University of New South Wales. The other four programs are Manufacturing Engineering and Management, Mechanical Engineering, Mechatronic Engineering and Naval Architecture. A special feature of the School's program structure is that the first two years are common and it is not necessary to finalise the program choice until the Second Year has been completed. In the first two years, basic engineering and science courses are studied, whereas the later two years are concerned with specialised engineering applications. In the third year we teach the basics of aerospace engineering, such as aerodynamics, flight dynamics, propulsion, systems and avionics. While in the fourth year, more advanced topics are taught, we also try to pull together all the knowledge accumulated and equip the students with skills to be able to design any aerospace vehicle of the future.

We define future aerospace vehicles to be ones that are improvements of existing vehicles or ones that encompass novel or revolutionary design, operational or performance concepts. In the tertiary teaching environment it is virtually impossible to demonstrate the implementation of the entire design process from concept formulation to the production of the actual vehicle since any aerospace design is a very expensive exercise. Even in the real world of aerospace industries, a successful operational vehicle design may take years to fruition and cost millions of dollars. The present chapter has been written to describe how we have gone about the design task using both conventional and modern tools of investigation. We will demonstrate the design process through a few test cases.

THE BASIS OF OUR APPROACH

We have adopted an approach what may loosely be called advanced design project study (Yauwenas et al, 2013). It is important to note that 'advanced project design' is not a well publicized area of aerospace industry and often non-existent in some industries. The advanced project design group provides the groundwork for the most severe

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