Aerospace Engineering Undergraduation Course in UFMG - Perspectives of uses of Problem Based Learning

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Abstract: The undergraduate course in Aerospace Engineering (AE) in UFMG has been using Problem Based Learning (PBL) for a long time applied to Aeronautics. Since the Astronautics branch of the course is new, tools for developing the area are still being built. Considering that the number of professionals involved in this area is small, an alternative is to join the Systems Engineering (SE) undergrad course in order to built an effort to bring a tool that is important for both courses. Since even a small satellite represents a challenge for designing, building, launching and operating, we believe that it is a very suitable tool for both courses, not excluding other engineerings that are present in our University. Even though the University has a long tradition in designing and building airplanes, the SE is not a well developed and applied tool in this context. The challenge is not only adapting the labs and tools for this new use but mainly integrate in this context the use of SE and Project Management from early projects, in order to bring it to the routine of the course. In this context, the use of PBL helps not only to make a better use of the facilities but also doing it while teaching and preparing the students of many engineering courses to a hands on Project. The efforts include preparing handbooks suitable for the University reality and joining a group to study Cansats and CubeSats.

Keywords: Teaching, Problem Based Learning, Systems Engineering, Project Management

History – Aerospace Engineering at UFMG

In 1927 the institution of UFMG brought together the four undergraduate institutions existing in Belo Horizonte, among which the Engineering School (1911). In 1954 it was responsible for preparing Mechanical / Electrical engineers, while Mechanical Eng. course started in 1963, when the then student Cláudio Barros created the Center for Aeronautical Studies (CEA). After becoming a Professor, he got the recognition of Mechanical Eng. course with certification in Aeronautical Eng. (1975). By 2009 it evolved into Aerospace Eng. (AE) course, with both certifications in Aeronautics and Astronautics. In 2010 the undergrad course in Systems Eng. (SE) was created under Electrical Eng. department. Clearly both courses have a lot in common and can benefit from a joint task regarding teaching methods.

Facilities and Challenges

Many labs have been built and equipped during last years, aiming mainly Aeronautical Engineering applications. Nevertheless, all facilities and equipments can be easily used for Astronautical demands as well, with adapted focus [1]. Among those labs one can name Aerospace Fabrication (CEA), Flight Testing (Hangar), Wind Tunnel (equipped with a small and a large version), Optimization, Flight Simulation, Control, and others.

PBL in Aerospace Engineering

The main characteristics of Problem-Based Learning (PBL) is the focus on the student, in an organized context of a problem, where the teacher is a facilitator of the process [2]. In this context, small satellites such as CubeSats are an excellent tool for involving the students in real projects, where theory is applied to a device and abilities other than technical ones, such as interpersonal interaction are to be developed [3]. Also, all steps of a space mission can be explored, from mission concept, development, testing, operation and end-of-life, using both AE and SE techniques and knowledge.

AE and SE Education Using Small Satellites

Even though UFMG has tradition in airplane design, SE tools were never explored in this context. Considering that Astronautics branch of the course is somewhat new, and knowing that in a new context it is easier to implement new practices, production of handbooks of good practices of SE for academic satellites is in course, taking into account the reality of the University. The use of such a formalism in a relatively simplified and device is interesting so as to teach the students the techniques and to use more realistic methods while solving a real problem. Even in a small mission there is the need to integrate and test different areas and subsystems, along with a proper understanding of the problem, its requirements and procedures from conception to end-of-life. All these analyses can be performed in a device much cheaper than a traditional satellite. In order to get to use those kind of tools, an effort is being made to understand the real situation of the University in terms of facilities, resources (both human and material) and built knowledge. The teaching program for a BS in AE is also being considered in this process, in order to provide the students with the technical information to be used along with SE methodology [5]. Currently, a program with optional subjects for both AE and SE courses is being built so as to merge the subjects to the students who have both interests.

Conclusions

The first steps to introduce small satellites in a University that already counts on good facilities and labs must start not with the design and fabrication of designs themselves, but with a change in the way that knowledge is spread and documented among the students. The insertion of key Systems Engineering tools and practices even in simplified devices allow the students to apply a systemic way of thinking that leads to the optimization and increases the chances of a successful mission. In order to achieve those goals, a body of knowledge applied to UFMG conditions is being built by the students themselves. This material will be used in future academic missions.

References

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