

The Experience of Helicopters subject- course in the

A Proposal on Technology Dissemination

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Abstract— An experience developed by the authors in the design of educational tools, funded on multimedia support for using in teaching, will be presented. These tools have been used on the subject of Helicopters, <http://ocw.upm.es/ingenieria-aeroespacial/helicopteros> at the Universidad Politécnica de Madrid (E.U.I.T. Aeronáutica). Throughout more than ten years, these didactical and educational elements have been defined and developed. It has the singularity that most of them have been designed for undergraduate students, as a part of their end of degree projectwork. This peculiarity has led to a wide range of proposals and solutions, as well as an appropriate approach depending on the level of knowledge. The evolution of tools for developing these materials will be presented, discussing advantages and disadvantages. Finally, we will advance the new materials which are being prepared at present.

Keywords-component; OCW; Open Course Ware; Helicopters course; Open Educational Resources; open access; learning object

I. STATE OF THE ART

There seems to be a general consensus within all social contexts that the evolution of the educational system should keep pace with the rate new development in the Information and Communication Technologies are produced, thus new teaching methods capable of both maintaining the strong points of traditional teaching and satisfying the needs of present society have to be devised [10].

Throughout the years, an alternative teaching method such as distance learning had moved from correspondence learning to educational forums with video conferences and teleconferences. The spread of the internet and the development of new educational software have brought with it a more flexible education form which has been named as virtual education.

The last step in the evolution of virtual education consists of Open Content Resources and, in special, the Open Course Ware project, initiated by the MIT [3], [7], [8], [11] and which has been followed by many universities all over the world. This educational proposal moves beyond virtual education or the

electronic classroom. The new concept is based on the idea of making knowledge contents available not only to higher education students but also to any person wishing to expand his/her knowledge on any specific theme or to scholars who would like to be informed of the new approaches to specific matters by other universities

II. THE CONCEPT OF VIRTUAL LEARNING

By combining the use of different technologies, teaching methods [1],[2] and instructors, virtual learning has taken education to a point that traditional teaching would have never imagined to reach, at least with respect to flexibility and availability (at any time and from any place). Virtual learning reaches its utmost peak when technology is developed to the point that the three teaching methods can be integrated: Asynchronous Learning, Synchronous Learning, and Self Learning.

The concept of virtual learning implies adapting education to the resources, means and circumstances of present society.

Experts [5] define the concepts of virtual learning and virtual classroom as follows:

- Virtual Learning (VLE). Distance teaching/learning process based on a virtual learning platform which presents a cooperative learning style full of new didactic resources and a new student centered teaching approach.
- Virtual classroom: learning environment where teacher and student are separated by time and space and which takes the place of the actual classroom.

The following are some features of virtual learning methodology:

- It is structured round a telecommunications net and constitutes a new technologies alternative to traditional correspondence-based education.

- Teacher and student need not to coincide the same time and in the same place.
- The student abandons his/her passive role to play a more active part in the learning teaching process.
- The teacher's part is that of a content facilitator.

If both conventional and virtual models are compared, it will be noticed that the first is a teacher's centered model from whom all resources originate while the centre of the virtual model is for the student to whom all resources are directed.

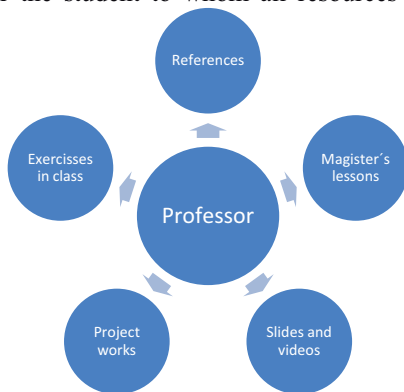


Figure 1. Teacher's centered model

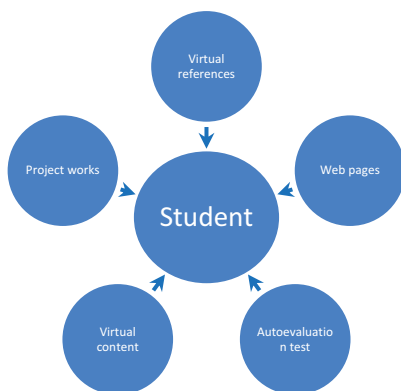


Figure 2. Student's centered model

Virtual learning methodology is based on two main basic pillars: the methodological approach and the technological development.

- Technological development
 - The web based didactic materials incorporate the classical elements of a self-learning model: introductions/background materials, objectives, contents, tasks and exercises, self-assessment activities, dictionaries,...
 - It is important to take advantage of the internet's potential as a communication channel for content design: interactivity, multimedia nature, global access, and live updated information.
- Methodological approach

- It is essential for these materials to be well structured from a pedagogical point of view.
- Guiding the student's learning process adequately and emphasizing personal support and training is indispensable.

III. OCW-UPM PROJECT

Open-course-ware is a good example of the initiatives that have appeared in recent years to promote free unrestricted access to knowledge [6], relating to virtual learning and using the concept of knowledge sharing as the key idea.

In April 2001, the Massachusetts Institute of Technology launched the OCW-MIT [8] initiative with the collaboration of the William & Flora Hewlett Foundation and the Andrew W. Mellon Foundation. Through this scheme the MIT offers free access to the materials its professor's use in their courses, together with a study guide.

It aims at providing a free, easy and sensible approach to teaching material for educators in no-profit institutions, students and self-learners worldwide.

This resource has made a great impact and has led other well-known international universities to adhere to the project, developing their own projects in coordination with the OCW-MIT. The Universidad Politécnica de Madrid (UPM) decided to take part in this project within the Open Course Ware-Universia web site.

IV. USING THE TEMPLATE

As a consequence of the UPM entering the project all its faculty members are offered the opportunity of participating.

Since 1998 the authors of this article have been developing several multimedia didactic materials for the different subject courses offered by their department (Aerotecnia, Escuela Universitaria de Ingeniería Técnica Aeronáutica). An important part of these materials have been designed especially for the subject Helicopters which is clearly a technological oriented subject with a great scope for technical materials.

In the initial stages of a project for the development of didactic materials it is quite advantageous to have a numerous group of collaborators. What we proposed was that a little part of our students' Final Project would incorporate a multimedia presentation as a project's resume or for presenting the conclusions they had reached.

This proposal obtained such an spectacular result that it led us to go one step further and to offer some of our students the possibility of focusing their Final Projects on the development of multimedia tools to be used in the Helicopters subject course. It was the professor's task to set out the topic, the content to be dealt with and the options the tool would have to offer. The student would have to make some decisions relating the visual appearance and the computer tool to be used.

This working technique let students express their ideas relating the working support and the user's interface to be used. Hence the tools offered at <http://ocw.upm.es/ingenieria->

aeroespacial/helicopteros keep a thematic unity combined with a variety of presentations modes for which users have seemed to be grateful.

The development of the project has required continuous monitoring on the part of the faculty, analyzing the results obtained and presenting the students with several alternative solutions to each problem. The more materials were developed to cover the course's different parts the fewer the number of choices offered to the students. We must also admit that not all projects have been successful and occasionally, after great efforts were made on the development of materials which did not achieve the results expected and were never used.

There was a shortage of web based materials on such an specific topic as Helicopters, both from the theory of flight point of view and from the description the main systems point of view. This is what many users from outside the UPM have let us know.

V. EVOLUTION OF DIDACTIC RESOURCES

Our subject-course inherits some of the materials and resources developed by Professor D. Ángel Barcala Herreros during the 70's decade.

The following figure provides a brief resume of the technological evolution of multimedia resources used in the subject Helicopters, which could probably be extrapolated to many other subjects in the last 30 years.

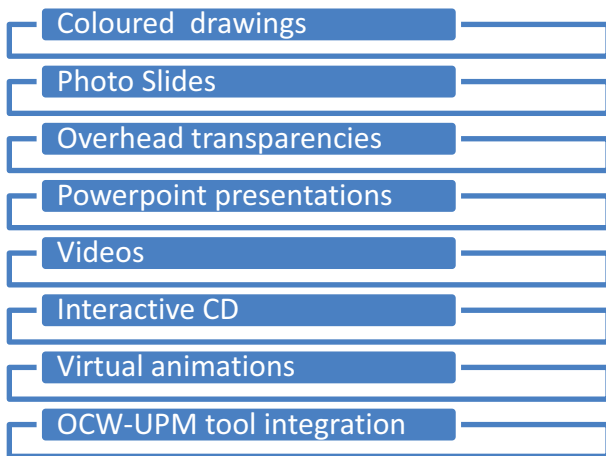


Figure 3. Technological evolution of multimedia resources

Coloured drawings, in A1 size sheets, were used as an alternative to compensate for the lack of real helicopter parts and pieces for assembling practice.

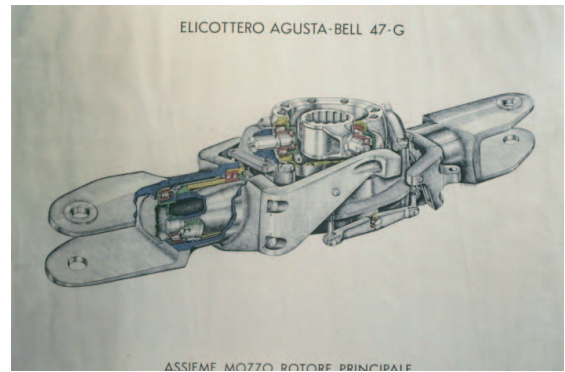


Figure 4. Coloured drawings in A1 size sheets

Figures from bibliographic references [11], [12] are a basic materials support of a course on helicopters at any university in the world. These figures, rather fantastic, have been used for teaching future engineers all around the world during several decades.

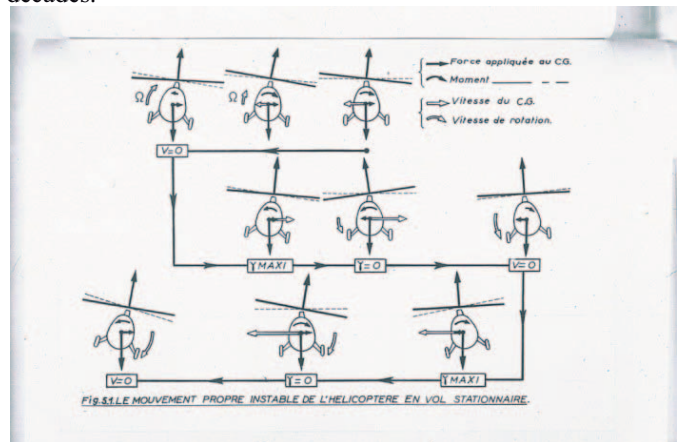


Figure 5. Basic materials support for any course on helicopters. From [13].

Reproducing these material by means of slides or transparencies allow us to take them into the classroom. They became a fundamental tool for lessons. They allow to show the student a great number of the helicopter components, and systems, in the process of revision or assembly, which would not be possible to appreciate otherwise.

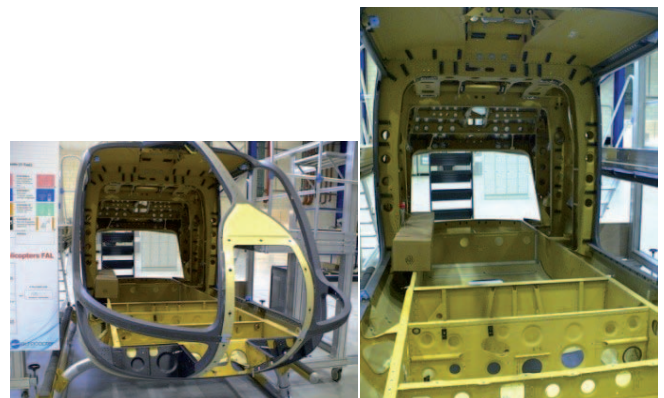


Figure 6. Different phases (a) of the mounting process of an helicopter. Copyright: the authors. Licenced by Eurocopter, an EADS Company.



Figure 7. Different phases (b) of the mounting process of an helicopter. Copyright: the authors. Licenced by Eurocopter, an EADS Company.

If original helicopter manuals and pictures of the systems are available, a .ppt (or any other) presentation can be prepared for the students to get to know and recognize different helicopter parts and systems. By taking the computer into the classroom the teacher has seen how a new wide range of teaching materials, not only static but also moving images, has opened.

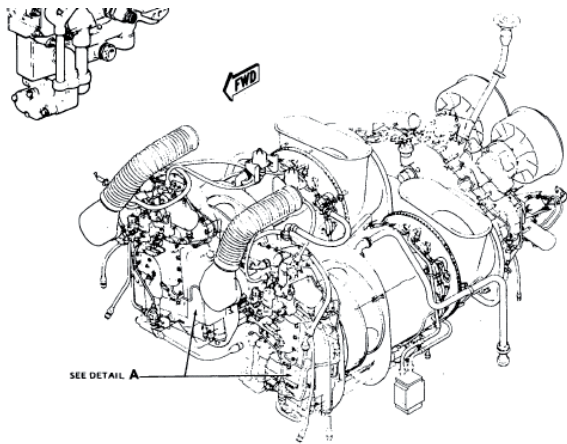


Figure 8. Comparing technical manual information and photos for the same component. Copyright: the authors.

Animations represent the most recent step in the evolution of the tools designed and used for teaching, in our field that means helicopter systems in movement. Some animations show rather clumsy movements but some other reproduce perfectly well some complex movements such as for instance the flow inside a helicopter turbine, as in the figure.

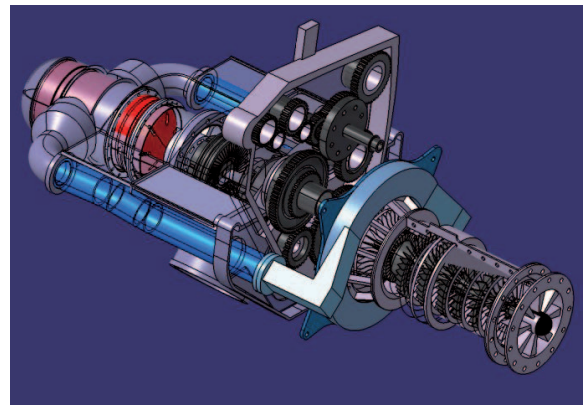


Figure 9. Turbine helicopter's animation

One of our main aims had always been to be able of reproducing the movement of the helicopter rotor in its three degrees of freedom, with all its linkages (pitch, flapping and drag hinge).

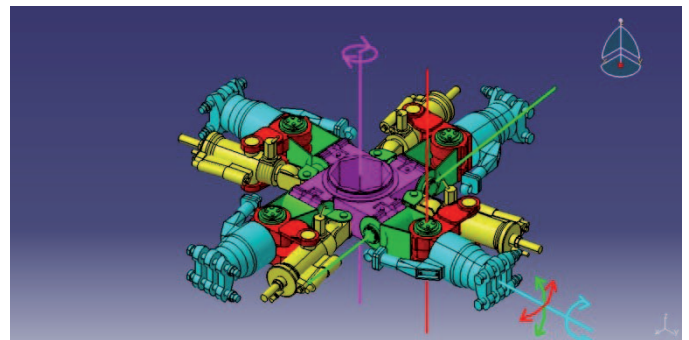


Figure 10. An articulated rotor head helicopter

Nowadays, we need animations to show some of the present alternative solutions to the traditional articulated rotor such as the one in the figure.



Figure 11. New concepts on rotor head helicopters. Part a. Copyright: the authors. Licenced by Eurocopter, an EADS Company.

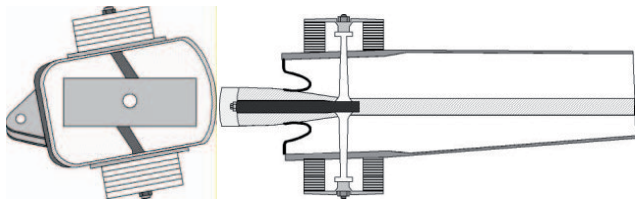


Figure 12. New concepts on rotor head helicopters. Part b. Copyright: the authors. Licenced by Eurocopter, an EADS Company.

VI. THE TOOLS

The tools used for the design multimedia teaching programs have also undergone a noticeable evolution.

First, since the materials were designed for the classroom and by the professor, we focused on Interactive CDs, in that moment -ten years ago- the tool we used was Macromedia© Direct.

As the spread of the Internet was wider and wider, both learning contents and tools underwent a new evolution. A were aware of a new reality: we had students from outside our University. Our answer to this new challenge was the elaboration of html materials and Macromedia© Flash animations. The results were outstanding. Students used the materials extensively. We seemed to have achieved the objective we had been looking forward for so long: making quality animations of the main helicopter components and systems available for our students.

We started to complement those animations with more materials taking our own recordings as the starting point.

As a complement to these recordings of tuning, start and shut down processes we started to produce our own CATIA® material developments. CATIA® is the most characteristic 3D aeronautical design tool and as so it is used by most aeronautical engineering companies. We used CATIA® V5 R14 (Dassault Systems). The field of design specifications this program allows is very wide, ranging from the simplest piece to the most complex part. With this tool one can perfectly show all the movements of the tilting plate of the helicopter rotor head, and even analyze the movement of each independent part.

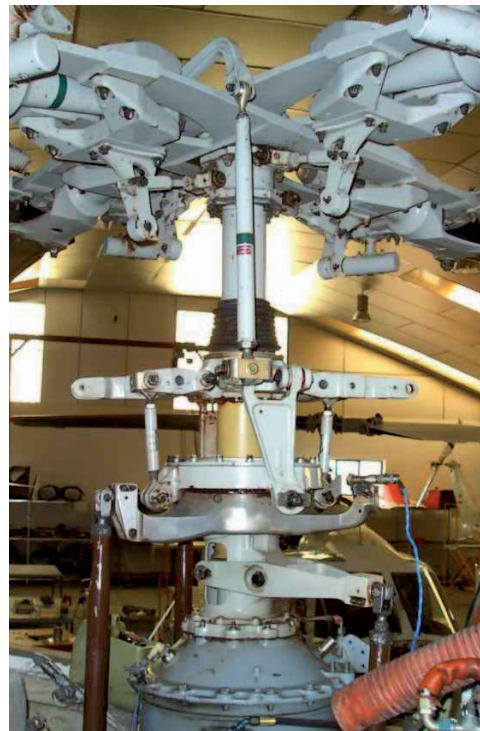


Figure 13. Bell-Textron rotor head helicopter. Copyright: the authors. Licenced by Bell Helicopter, a Textron Company.

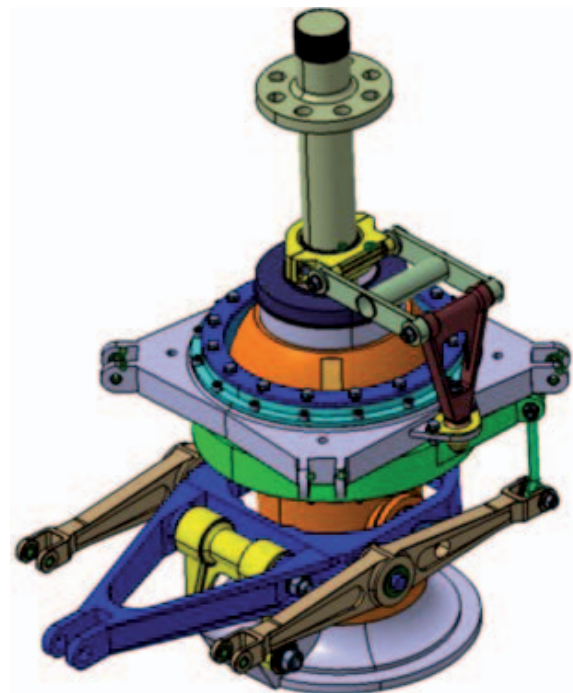


Figure 14. CATIA animation of the previous rotor head helicopter

Sometimes this tool's capacities seem to be boundless, it allows the combination of hundreds of different variables all at the same time, as well reaching a satisfactory result for a problem.

CATIA®'s most famous capacity is that for developing 3D projects, enabling the user to design and modify actual size

parts, to relate one to the other and to get assemblies with volume capacity that very few programs can offer.

VII. CONCLUSIONS

By the time the UPM decided to start its OCW-UPM project, in the spring term 2007, we had already been developing multimedia materials and tools for the subject Helicopters for a long time. All we needed to do was to arrange and organize all the material in accordance with the OCW learning concept, that is, to provide free access to the materials and instruments used for the teaching of this subject course; as well as agreeing to not claiming copyright the reproduction of our materials and tools.

We must insist on the fact that OCW is not a platform for distance learning for our students; for that purpose some actual platforms such as Aulaweb (Universidad Politécnica de Madrid's tool for tele-education) and Moodle are available. It is more a classroom lesson open to the world. We have received feedback on our materials being used from a wide variety of fields and contexts.

The good news is that we still have materials in store and that they will be ready to be offered as soon as a last revision is made.

VIII. ACKNOWLEDGEMENTS

Quite an important part of our materials would have never been developed but for the enthusiasm, creativity and effort of the following students (already engineers now) Arturo Villegas, Raquel Prado, Carlos A. Naval, Álvaro Orejas y Virginia Vergara.

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