

MATERIAL IN VIDEO FORMAT AS A SUPPORT IN MATH COURSES IN TELECOMMUNICATION ENGINEERING

M. Breitman, G. Sáez Moreno
Department of Applied Mathematics IV
UPC-BARCELONATECH – Universitat Politècnica de Catalunya
Jordi Girona 1-3 (08034) - Barcelona (Spain)
monica@ma4.upc.edu

ABSTRACT

The new defined degrees in our university follow the recommendations of the European Higher Education Area (Bologna Declaration). Among these recommendations, our teaching work should be focused on student work and learning student process. That is why our proposal is devoted to achieve a more active classes supported by the continuous work of the students.

We propose our students to solve certain exercises and once they have thought them, we show the resolution in video format (along with a PDF file). The whole activity is performed in our complementary virtual course that uses Moodle platform (Atenea). We believe that the resolution in this format is well received by this generation of students who are immersed since childhood in new IT technologies. The use of this material can be understood in several ways, we have chosen the one in which the resolution is made in a LATEX format and the use of CAMTASIA allows animating the resolution by means of a voice-over.

Surveys of students encourage us to continue this line of work and just as the comments of our colleagues.

1. INTRODUCTION

The Escola Tècnica Superior d'Enginyeria de Telecomunicació de Barcelona (ETSETB) [1] is the Telecommunication Engineering School at the Technical University of Catalonia (UPC). ETSETB is finishing the changing process, adapting its studies to the European Higher Education Area recommendations, offering Engineering degrees in different specialities. This change is much more than a remodelling program, it brings a modification in the style of teaching, from teacher-centred to student-centred.

The university attentive to these changes has invested in platforms that allow active communication between teachers and students. This platform (Atenea), performed through Moodle [2], can be used for many activities, from placing the bibliographic material, making a calendar of events or placing test scores to even give the possibility of taking examinations.

From another point of view new generations of students has a different way of learning; they are closely linked to new technologies so that nowadays it is unthinkable for them to study computerless.

Motivated by these changes and encouraged by the institutions, we teachers are trying to find innovative teaching materials which best capture the attention of students, leading to greater and better understanding of the concepts.

We think it is important that students attend classes because we believe that the explanation of the concepts and exercises provided by teachers develop a greater comprehension of students that they could obtain from reading a text. Our objective is to create materials that lead students to a continuous study of the subject. A part of this material is designed to reinforce learning outside the class time and the other part is intended for short assessments that allow the correction of mistakes along the course.

Our work begins with a survey of existing proposals in video format materials, among which we highlight: websites with resolutions of exercises (see [3]), some of them with step by step resolution but without voice (see [4]); there are others with videos of a professor explaining exercises (see [5]), there are websites that propose quizzes too (see [6]) and furthermore some of the most prestigious universities offer complete video course in 45 minutes to 1 hour sessions (see [7]). A capture of one of the videos in [7] is:

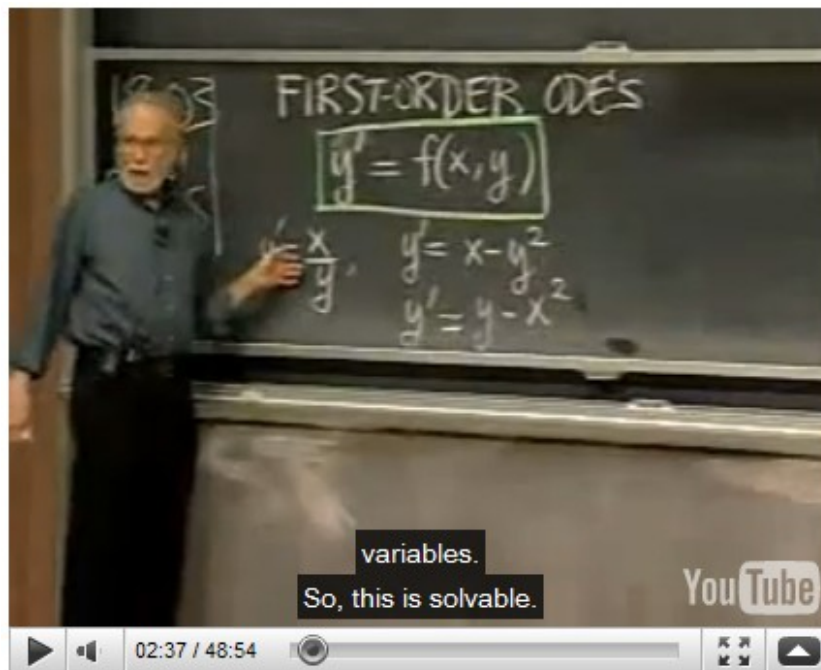


Figure 1: Professor Mattuck in a video of MIT course on ODE

Among all the proposals, we decided on making videos of solving exercises and again conducted an investigation of alternatives to this project. The most common options are in the following four captures:



Figure 2. Recording of a classical class with the teacher in the foreground

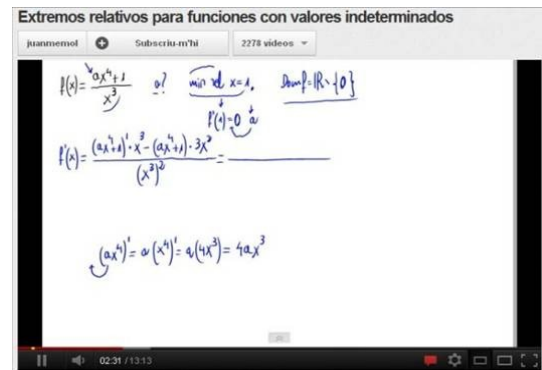


Figure 3. Recording a PPT sequenced

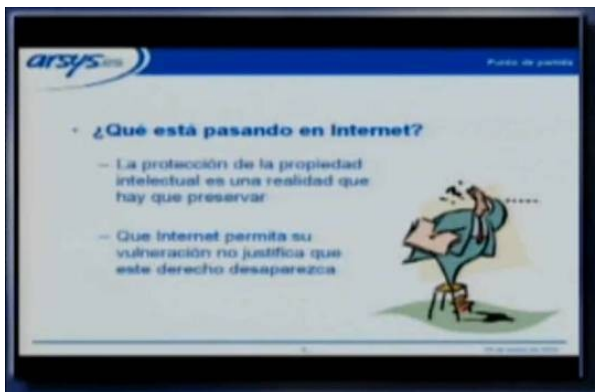


Figure 4. A written explanation with a digitizer or a block with pen recorder.



Figure 5. Recording software generated animation in which an avatar explains.

At this point, we note that it is virtually impossible to find a material that fits perfectly into our programs, but it's a good idea to implement material in video format regarding the students' positive attitude towards materials of new technology, then we decided to start with the realization of our own materials.

2. EXERCICES IN VIDEO FORMAT

Our proposal of videos is devoted to solve model exercises that can help our students to learn more in depth the mathematical contents of our subjects and in an easy way. But our proposal is in no way like a video on the popularization of mathematics. In the Internet it can be found similar proposals, mainly math classes recorded with a video camera or some videos recorded with a note taking application as Windows Journal using a Tablet PC or a digitizing tablet.

The procedure to create the videos has been the following one. First of all we produce the resolution of the exercise in LATEX format by means of Scientific Notebook. The choice of Scientific Notebook is motivated by the fact that this program allows us to directly write in the DVI with no compilation. Secondly we propose a simple script that mainly follows the resolution of the exercise but

including in the timeline the distribution of the text (with formulae and graphics) and the content of the voice-over. In fact this script tries to express how to explain in the best way the exercise with images and a voice-over. Thirdly we record the animation using screen recording software and after that we do the same with the capture of the voice-over. The difficulty to record both things at the same time is very high even for simple videos like these ones. We use Camtasia [8] as screen recording software but there are some other recorders as ZD Recorder. The animation is produced with a usual CTRL+Copy, CTRL+Paste technique from the resolution document to a blank document. In this way we can use some graphics that evolve in the timeline, for instance diagrams of function compositions. If a big computation uses too much part of the recorded area it can be erased from the screen after the explanation leaving the main result of the erased computation. An example of this difficulty appears when we do matrix computations. Finally, after many corrections of the previous process, we generate an MP4 version and many other video formats as well as the master file of the video. A capture of one of our videos is the following one:

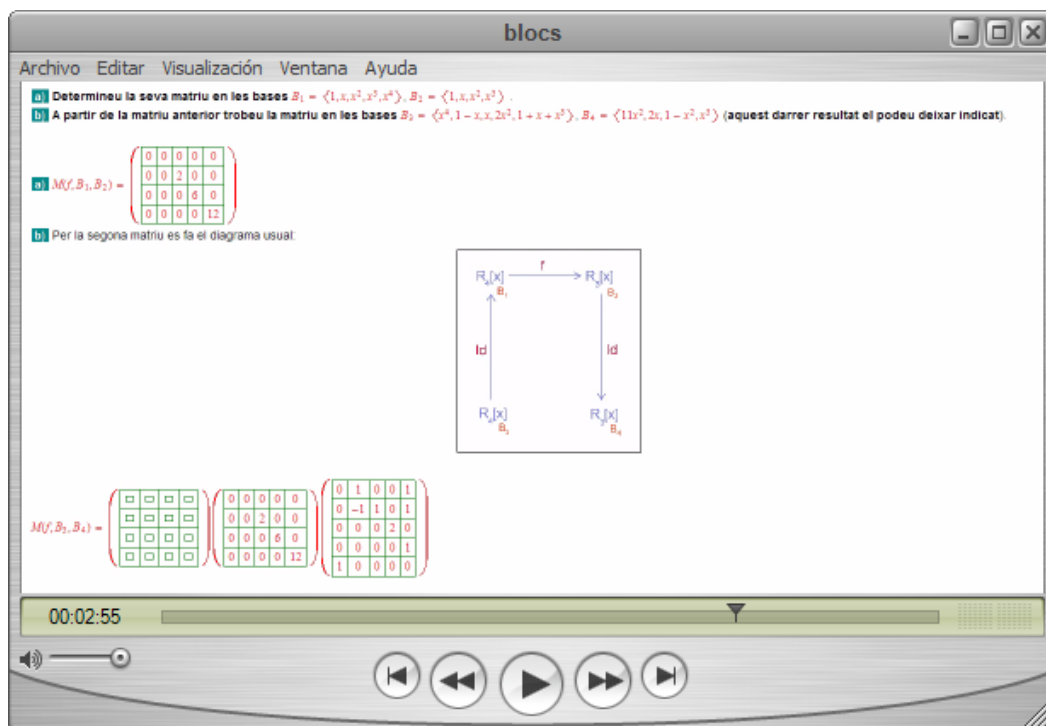
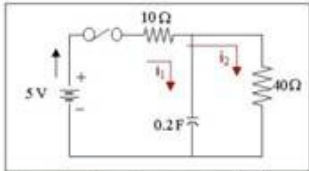


Figure 6: Caption of one of the proposed videos

This video is about a typical exercise of linear applications in different bases. The voice-over explains the process to fill the matrix with the correct numbers at the same time that these numbers appear in the video. In this case the diagram is evolving while the explanation is progressing.

Another proposed exercise is the application of mathematical concepts to engineering issues themselves; an example is the use of the Laplace transform to solve electrical circuits, as shown in the following capture.

En el circuit de la figura, el condensador està descarregat quan $t = 0$. Si després es tanca l'interruptor, trobeu les intensitats i_1 i i_2 , i la càrrega a C quan el temps t és més gran que zero.



$$2i_1 + 2i_2 + \int i_1 dt = 1 \quad (1) \quad i_2 = \frac{1}{10}(1 - 2i_1) \quad (2) \quad 8i_1 + 5 \int i_1 dt = 4$$

Després fem la transformada de Laplace a les dues bandes de l'equació.

Nota: $\mathcal{L}\left\{\int i_1 dt\right\} = \frac{1}{s} + \frac{1}{s} \left[\int i_1 dt\right]_{t=0} = \frac{1}{s} + \frac{q_0}{s}$. En aquest cas, $q_0 = 0$. Per tant, $\mathcal{L}\left\{\int i_1 dt\right\} = \frac{1}{s}$.

$$8i_1 + 5\left(\frac{1}{s}\right) = \frac{4}{s} \Rightarrow \left(8 + \frac{5}{s}\right)i_1 = \frac{4}{s} \Rightarrow (8s + 5)i_1 = 4$$

Figure 7: Caption of one applied exercise video

In this case an electrical circuit with two meshes is analyzed and using Kirchhoff's laws and the Laplace transform yields the current in each mesh.

As subproducts of the video we have the LATEX file with the resolution (that can be modified for other proposals), the PDF version of the resolution and the PDF version of the formulation of the exercise that can be used, together with the video. This material is linked in the Moodle Virtual Campus associated to our subjects (Atenea). All of these files are available (see [9], [10]) under Creative Commons Licenses in the UPCommons [11] open repository of our university. These tools are also available and discussed by members of the Research Group on Mathematics Learning Methodologies (Grimath, see [12]).

3. OUR WEEKLY PROPOSAL

Our project is based on the continued work of the student so we need their commitment to carry out our objectives.

We ask students to keep an ongoing work. To encourage this work we provide exercises once a week, with an advanced time of approximately 3 days to solve. After this period, we post the resolution videos and include the written resolutions in PDF files.

Some questionnaires are proposed at the end of each thematic unit to check the acquisition of knowledge.

4. CONCLUSIONS

We teach mathematics in the first year of an engineering school and we believe it is an important occasion to introduce IT tools in mathematics to our students, who grow up surrounded by this type of technology.

We believe that this material will capture the students' attention, motivating them to work more but at the same time making easier the acquisition of knowledge.

The start of this project has represented an investment of much time exploring the existing options and once the decision was made many hours were used to take the first available materials. Nevertheless at this point, we believe that a coordinated effort between groups of teachers willing to share teaching material may represent a reduction of time and an increase in the quantity and quality of new videos.

Our future project has two different approaches. From the technological point of view, we want better technical solutions for videos, both to improve the final quality and to introduce new visual elements. Another aspect is to try to convince more teachers of mathematics in our department to form working groups in the generation of new teaching tools.

This paper was originally purely educational objectives, but we found very interesting the study of the new IT tools in the area of education in engineering schools.

5. REFERENCES

1. Escola Tècnica Superior d'Enginyeria de Telecomunicació de Barcelona de la UPC. <http://www.etsetb.upc.edu/>
2. Moodle: <http://moodle.org/>
3. Beltrán, J. Clases de matemáticas on line, <http://ed21.webcindario.com/id379.htm>, 2010
4. Taylor, J., Aid for calculus, <http://www.jtaylor1142001.net/calcjat/Contents/CalcaCont.html>, 2010.
5. Tisdell, Ch, 2nd order, linear homogeneous ODE with repeat roots, <http://www.youtube.com/watch?v=mTxqlmPWmeA>, 2008
6. Wims, WWW Interactive Multipurpose Server <http://wims.unice.fr/wims/wims.cgi?session=FBE03DCEBA.1&+lang=en&+module=U1%2Fanalysis%2Foefode.en>, 2010.
7. Mattuck, A. Video lecturers. <http://ocw.mit.edu/OcwWeb/Mathematics/18-03Spring2006/VideoLectures/index.htm>, 2006.
8. Camtasia: <http://www.techsmith.com/camtasia.asp>
9. Lineal Algebra videos: <http://upcommons.upc.edu/video/browse?type=subject&order=ASC&rpp=20&value=%C3%80lgebra+lineal>
10. ODE videos: <http://upcommons.upc.edu/video/browse?type=subject&order=ASC&rpp=20&value=Equacions+diferencials>
11. UPCommons: <http://upcommons.upc.edu/?locale=en>
12. Grimath: <http://grimath.ning.com/>