

AN ACTIVE LEARNING APPROACH TO TEACHING A GRADUATE COURSE ON THE HISTORY OF TELECOMMUNICATIONS

Antonio Pérez Yuste
Universidad Politécnica de Madrid
Madrid / Spain
antonio.perez@upm.es

Abstract

A first-year graduate course on the History of Telecommunications was formally incorporated into the School of Telecommunications Engineering at Technical University of Madrid in the year 2005. This course is intended for students who have completed an undergraduate degree in engineering, no matter if they are actually electrical engineers or not. It comprises a number of study-units amounting to 3 ECTS (European Credit Transfer System), oriented with an active learning approach in order to mainly prepare students to think for themselves after the course is over. The first objective of the course was to make the subject easy to follow for all the students, even for non-electrical engineers. As a second objective, it was considered to use a teaching methodology based on non-traditional methods, such as blended learning, encouraging students to follow the lessons by their own. And as a final objective, it is expected students to have a proactive attitude towards the study of this discipline, challenge them with an active learning point of view.

Keywords

Active Learning, B-Learning Course, First Year Graduate Course, History of Telecommunications, Moodle Learning Management System.

1. INTRODUCTION

Despite the importance that is generally given to the thought process behind some remarkable engineering achievements and to the value that is usually attributed to those case histories that show the ways in which a certain technical system contributes to the progress of humankind, technical universities all around the world seldom focus their attention on teaching the historical aspects of engineering and technology [1]-[2]. Spanish technical universities are not an exception, so this was firstly the reason why a graduate course related to the History of Telecommunications was proposed, three years ago, in the School of Telecommunications Engineering at Technical University of Madrid, Spain.

This proposal was very well welcomed and the course was incorporated, in 2005, in the program of studies of a new Master degree in Accessible Systems and Services for the Information Society designed after the approval of a Royal Decree regulating official postgraduate studies in Spain [3]. This Master Program was started, for the first time, in the academic year 2006/2007, including such a course on the History of Telecommunications during the fall semester of the first year, with a number of study-units amounting to 3 ECTS (European Credit Transfer System).

The course is intended for students who have completed an undergraduate degree in engineering, no matter the discipline, having in mind the fact that they might be already employed. In fact, being this the case in the majority of graduate students in engineering in Spain, the most important challenge was to make the subject easy to follow for all of them but promoting, at the same time, a proactive attitude towards the study of the History of Telecommunications.

These and other objectives will be explained in next paragraph. After that, a brief description of the course activities carried out, as well as an account of the supporting materials and tools available to the students will be presented. A special attention will be paid to the well-known Moodle Learning Management System, which is used to help students carry out course assignments, allowing the teacher to follow their progress at the same time. Finally, the current status of the course will be

reported and the evaluation methodology applied, besides the academic results obtained by the students, will be reported.

2. OBJECTIVES

To study the history of any technique or science can become a very boring experience when the teaching process is exclusively done by means of lectures, more so when students come from an undergraduate engineering degree. In addition, if these students are already employed, then difficulties to gain their attention are highly increased. So the first objective is to make the course easy to follow for all students, both attending classes and finding time to carry out assignments.

Undergraduate engineering students are usually expecting to find technical subjects when studying a graduate degree in a School of Telecommunications. This means that topics of classes must be faced from a technical point of view, but without forgetting its social and economic implications. So the second objective of the course is to raise topics in class from a technical position but introducing, at the same time, social and economic issues.

As this course is intended for students who have completed an undergraduate degree in engineering, no matter if they are actually electrical engineers or not, prerequisites cannot impede students' progress in their general curriculum. This means that students' background have to be considered as low as was necessary for all to share a common knowledge on principles of telecommunications. So the third objective is to deal with course topics by starting from some technical principles well established.

Although the studying of a subject such as History of Telecommunications is usually dealt with using a theoretical point of view, it is very necessary to find ways for introducing hands-on experiences, so certain skills can be developed. These skills have to do, for instance, with searching archives, integrating information that comes from different sources, managing huge amounts of data and summarizing the most important while discarding the rest. So the fourth objective of the course is to introduce hands-on assignments join to lectures and other activities.

In addition, these hands-on assignments have to raise a challenge for students in order to promote a proactive attitude towards the study of the history of telecommunications. So the fifth objective of the course is to design practical activities related to the contents of the course, which can be done by students for themselves, but also completed with a collaborative work in class under the supervision and guidance of the teacher.

3. COURSE ASSIGNMENTS

In order to achieve the aforementioned objectives, five different types of assignments have been developed, all of them carried out along the course.

The first assignment consists of regular class lectures. They are all compulsory and planned in the evening hours with a length of one hour and forty minutes, each one. Usually, the lecturer is the professor in charge of the course but it can also be given for an invited specialized person. There are 15 lectures, in total. Each one is supported with study materials such as slide shows, book references, web pages, images, videos, papers and documents of any kind.

The second assignment has to deal with making of an in-class self-assessment exercise after each lecture, consisting of some quiz questions that can be responded as many times as needed. The results will not be taken into account to obtain final students' marks, being the main purpose of this assignment to gain students' attention for class lectures. In any case, the realization of this duty will be controlled.

The third assignment consists of the discussion of two selected classic patents, which must be done by means of a collaborative work in class under the direction and guidance of the teacher. Students have to carefully read the patents, understand their meaning and outline the innovations proposed by

the inventor. They have also to connect ideas enclosed in the patents with the state of the art at that time and try to find out what their social and economic implications were.

The fourth assignment consists of reading a book related to some of the topics included in the course. It is usually chosen a short book about some interesting episode on the history of telecommunications. This way, students can increase their knowledge by their own. References [4] or [5] have been used as reading books in past two academic years, respectively.

Finally, the fifth assignment consists of visiting one of the museums of telecommunications existing near the School of Telecommunications and selecting one piece on display in order to write a brief report on it. To find out who the inventor or manufacturer was, when it was invented or made, how it works and what it was used for, are some examples of tasks that have to be carried out. Some museums suggested to visit in past two academic years were:

- Museum of Telecommunications, School of Telecommunications, Km. 7 Valencia Rd., Madrid.
- Museum of Telecommunications, Telefónica Foundation, 28 Gran Vía St., Madrid.
- Museum of Post and Telegraph, Public Society of Post and Telegraph, 6 Tapia de Casariego St., Madrid.

Figure 1 shows an image of the building where is located the second museum above-mentioned. This museum is one the most interesting theme museum in Spain and touring its exhibition halls is highly recommended.

The final assignment of the course consists of doing an exam where some questions related to class lectures, to patents discussion and to book reading are asked. Total coursework load, expressed in work hours and in ECTS's (European Credit Transfer System), besides time for preparing and doing the final examination, is shown in Table 1. An equivalence of 30 work hours per ECTS has been used.

TABLE 1
COURSE WORKLOAD

Activity	Work Hours	ECTS's
Class Lectures	25	0.8
Self-Assessment	5	0.2
Patents Discussion	12	0.4
Book Reading	24	0.8
Museum Visit	10	0.3
Examination	14	0.5
TOTAL	90	3.0

4. TABLE OF CONTENTS

Table of contents for the course, including lectures and patents are shown next. In first place, the class lectures are listed:

1. Communication and Information
2. Early Telecommunication Systems
3. Born of Electricity
4. Electric Telegraphy
5. First Transatlantic Submarine Cable

6. A New Order: The World Telegraph Network
7. Telephony
8. A New Power: The Big Telephone Companies
9. Wireless Telegraphy
10. A New World: The World Wireless Web
11. First Transatlantic Radio Link
12. Broadcasting
13. Television
14. Wireless Telephony
15. A New Society: The World is One¹

And, in a second place, the list of patents used for in-class discussion is as follows:

1. US patent 174,465, 'Improvement in Telegraphy', by Alexander Graham Bell.
2. UK patent 12,039, 'Improvements in Transmitting Electrical Impulses and Signals, and in Apparatus therefore', by Guglielmo Marconi.



FIGURE 1
BUILDING WHERE IS LOCATED THE MUSEUM OF TELECOMMUNICATIONS OF THE
TELEFÓNICA FOUNDATION IN MADRID. SOURCE: MADRIPEDIA.COM

5. MOODLE AS A TOOL

In order to facilitate the teaching and learning of this course, assignments are all carried out with the assistance of the well-known Moodle Learning Management System. This educative platform has demonstrated to be one of the most suitable open source platforms for e-learning and b-learning purposes [6]. Moodle makes possible to create and share a wide variety of study materials by promoting a social and constructionist pedagogy (collaboration, activities, critical reflection, etc). In addition, it also allows the teacher to follow students' progress and each student to work at a different pace [7].

Different Moodle Modules has been used to encourage students' learning in this course, such as Resource Modules, Quiz Modules, Forum Modules and Assignments Modules. They are all adequately put together to get students achieve the overarching goals.

A general view of the course, as seen in Moodle, is shown in Figure 2. There is a first part to introduce general information on the course, besides a forum to communicate news and announcements to all teachers and students participating in the course.



FIGURE 2
GENERAL VIEW OF THE COURSE AS IT IS SEEN IN MOODLE

Every class lecture comes with one slide show that summarizes the most important ideas and details for students to remember. There are some flash animations too, in order to clarify how a certain system works. In addition, it can also be downloaded different electronic documents (papers, images, videos, etc.), which are proposed to those who want to know more about issues explained during each lecture. Figure 3 shows the look of one of the slides used during the fourth class lecture, related to Electric Telegraphy.

Patents discussions are mainly carry out in class. A collaborative working process join to a debate scenario is setting up with the aim to encourage the exchange of ideas between students and in order to get a common analysis of descriptions and claims included in those patents. But, to obtain a successful result, it is mandatory for students to do some previous tasks, including finding out more information from other sources and sharing their results with their classmates. These activities can all be done with the help of Moodle, as some interesting links to web pages related with those patents are included and a forum module is available both to post notes and to promote the exchange of information between students. Figure 4 shows how this part is seen in Moodle.

Book Reading assignment is mainly a personal task that students have to do along the course semester. The aim pursued is to increase students' knowledge on history of telecommunications, besides they can realize that a specialized literature on this topic is available in libraries. As a part of the course Moodle platform, it is also available a section where students can download an electronic copy of the book and where they can discuss about its contents by means of a forum. In the lower part of Figure 4 is shown this section as it is seen in Moodle.

Finally, information about museums to be visited along the course semester, as well as their addresses and opening hours are included in a different section of the course Moodle platform. As mentioned before, students have to select whatever piece on display was exhibited in one of the

suggested museums, to carry out a report about it afterwards. Once done, students must upload this report to the course Moodle platform, in any file format, in order to be assessed. Figure 5 shows the look of the Museum Visit Section as it is seen in Moodle.

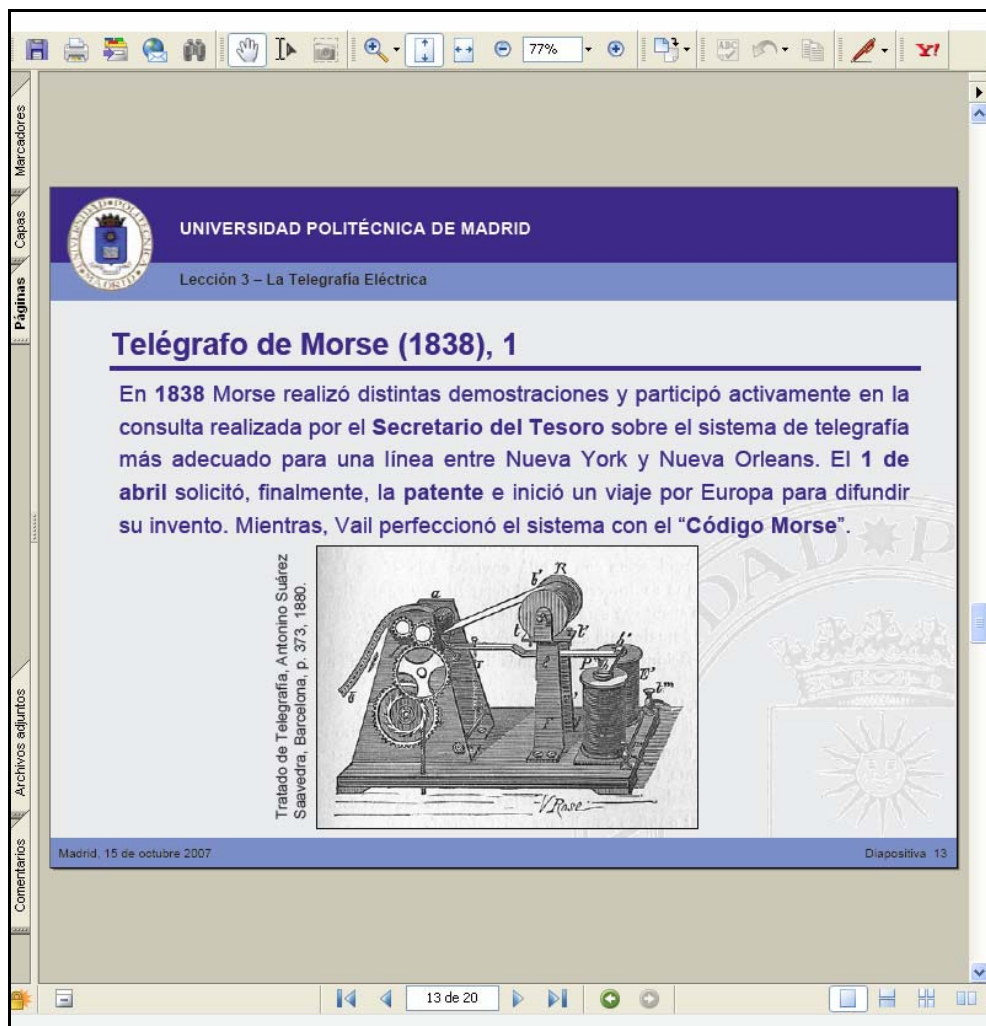


FIGURE 3
A SLIDE OF A CLASS LECTURE UPLOADED IN MOODLE

6. COURSE EVALUATION

The evaluation of students is done by using two different assessments: first, an in-class written exam is used to evaluate class lectures, patents discussion and book reading assignments and, second, a home written report about the piece on display in the selected museum is used to evaluate the accomplishment of this assignment.

To carry out the in-class written exam, students must have previously made all the in-class self-assessment exercises corresponding with the assignment referred in section 3 of this paper. Final evaluation is carried out by using a weighted distribution as found in Table 2.

Up to now, this course on the History of Telecommunications has been so far offered for two academic years, obtaining an evaluation mark distribution as shown in Figure 6. Results have been translated to the classical American letter grading system in order to use an international qualification system, easy to compare.



FIGURE 4
PATENTS DISCUSSION AND BOOK READING SECTIONS, AS THEY ARE SEEN IN MOODLE



FIGURE 5
MUSEUM VISIT SECTION, AS IT IS SEEN IN MOODLE

TABLE 2
WEIGHTED DISTRIBUTION FOR THE EVALUATION OF THE COURSE

Activity	Evaluation	Weight
Class Lectures	In-class exam	40 %
Patents Discussion		15 %
Book Reading		25 %
Museum Visit	At-home report	25 %
TOTAL		100 %

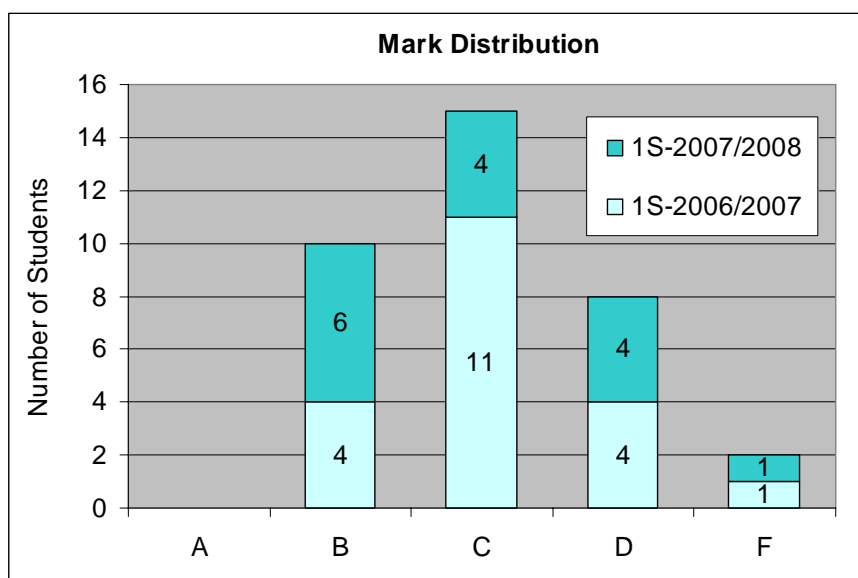


FIGURE 6
EVALUATION MARK DISTRIBUTION

7. COURSE SURVEY

End-of-course survey has been administered to the students every year in order to know their opinion. Although not everyone responded the survey (13 of 20, the first academic year, and 11 of 15 the second academic year), the result indicates a high degree of reported satisfaction.

Curiously, it has to be called the attention about this fact in opposition to the not so good results obtained in student's evaluation seen before.

The survey distribution is shown in Figure 7. Once again, results have been translated to the classical American letter grading system in order to gain a better understanding.

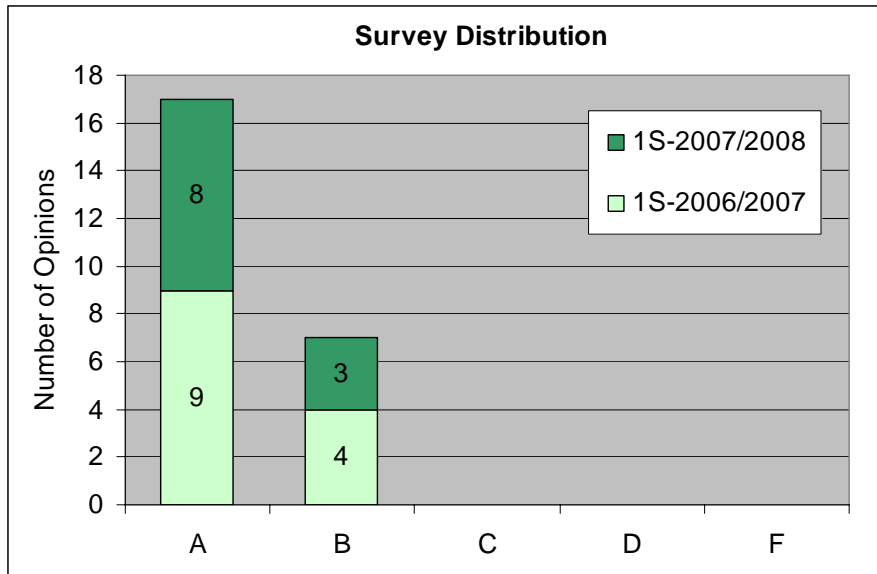


FIGURE 7
STUDENT'S SURVEY DISTRIBUTION

8. CONCLUSIONS

A first year graduate course on the History of Telecommunications has been introduced in the School of Telecommunications at Technical University of Madrid. This course was incorporated, in 2005, in the program of studies of a new Master degree in Accessible Systems and Services for the Information Society, and it is intended for students who have completed an undergraduate degree in engineering, no matter if they are actually electrical engineers or not. The course has been designed with the assistance of the well-known Moodle Learning Management System by means of which teachers and students are able to carry out the course assignments by using an active learning approach.

A list of overarching objectives, assignments for students and course contents through which can be accomplished these objectives, have been described. In addition, the type of assessments used to check whether students have met those objectives have also been drawn.

The current project status has been reported and the academic results obtained by the students besides their own assessment of the course have been presented. Although it has not been a long period of time to have any statistically meaningful result, those obtained in the two academic years of running the course shown a positive tendency. Nevertheless, it has to be called the attention about the high degree of satisfaction reported by the students in relation to the course, opposite to the not so good results obtained in their evaluation.

References

- [1] Jarvis, A., 'Why Teach History to Engineers?', *Engineering Science and Education Journal*, Vol. 10, n. 3, pp. 92-98, June 2001.
- [2] Condoor, S., 'Importance of Teaching the History of Technology', 34th Annual Conference on Frontiers in Education, Savannah, GE, 20-23 October 2004, pp. T2G/7-T2G/10.
- [3] Royal Decree 56/2005, 21 January, regulating official Postgraduate Studies, BOE n. 21, pp. 2846-2851, 25 January 2005.
- [4] De la Peña, J., 'Historias de las Telecomunicaciones. Cuando todo empezó', Ed. Ariel, Barcelona, 2003.

- [5] Sánchez Miñana, J., 'La Introducción de las Radiocomunicaciones en España (1896-1914)', Ed. Fundación Rogelio Segovia, ETSI de Telecomunicación, Madrid, 2004.
- [6] Graf, S., List, B., 'An Evaluation of Open Source E-Learning Platforms Stressing Adaptation Issues', The 5th IEEE International Conference on Advance Learning Technologies, Kaohsiung, Taiwan, 5-8 July 2005, pp. 163-165.
- [7] Rice, W., 'Moodle E-Learning Course Development', Rice, Packt Publishing, Birmingham, 2006.

¹ There is probably not a better title for the last lecture of the course than this one taken of Arthur C. Clarke's book 'The World is One'. Be this election a tribute to an engineer and science fiction writer who was also an historian. Arthur C. Clark passed away this year, on March 19.