

A study on the use of software applications in the context of Engineering Management education in Spain

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Although software applications have been used for a number of years by Spanish Engineering Management teaching institutions, there is not detailed information about the real degree of usage of software applications or the ability of these institutions to cope with the above mentioned difficulties. The study presented in this paper tries to shed some light on this issue.

Keywords Engineering Management education; software applications; European Higher Education Area

1. Introduction

The 1999 Bologna convention [1] gave birth to the idea of a common European Higher Education Area, which is currently under development. Together with the reconfiguration of the different national higher education regulatory systems, considerable attention is currently being paid to the redesign and reorientation of university curricula. The Tuning Project [2], a comprehensive study financed by the European Commission including more than 100 academic experts all over Europe, concluded that the new university curricula should be configured around the concept of *competence*. A great importance is given to the learning outputs (competences, abilities, etc.) and to the adaptation of these outputs to the different professional profiles demanded by the job market. At the same time, making the learning process more flexible, the use of innovative teaching techniques and a focus on providing means for the autonomous learning of the students is also encouraged.

In the Engineering Management field, the use of software applications provides a good opportunity for addressing some of the challenges posed by the Bologna convention. For example, educational versions of ERP (Enterprise Resource Planning) systems could be used to generate capstone projects [3]; simulation software tools could help to teach the basics of simulation in a practical way or to illustrate some production planning concepts [4] such as factory lay out design (client-server architectures provide additional flexibility, enabling different remote learning formulas. Obviously, a number of difficulties must be addressed in order to realize the full potential of these software applications. License costs, faculty commitment and preparation, installation and cost of the necessary facilities are some examples.

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2. Objectives

A study on the use of software applications in Engineering Management education was designed with the following objectives:

- To obtain detailed information on the current use of software applications in Spanish Engineering Management teaching institutions.

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- To investigate the ability of these institutions to explore the full potential of software applications with the idea of adapting to the new university curricula in the context of the new European Higher Education Area.

In order to conduct this study, a web questionnaire was created (it can be found in <http://ingor.selfip.com/formulario/>). Section 3 provides a detailed description of the methodology of the study. The main results are presented in section 4. Finally, some conclusions are provided in section 5.

3. Methodology

3.1 Description of the population

The population of study comprises all teaching institutions that provide Engineering Management education in Spain. At the current moment, Engineering Management education is provided both as a specialization field inside the Industrial Engineering degree and as an independent Masters degree. The number of institutions that offer these studies in Spain is 19 (both state and private). For the purposes of the study, a sample comprising the institutions part of the ADINGOR association was chosen (Association for the Development of Engineering Management in Spain, <http://www.adingor.upv.es/index1.html>). 15 institutions providing Engineering Management Studies are part of this association (which corresponds to a 79 % of the total number of Engineering Management institutions).

3.2 Description of the questionnaire

As explained before, a web questionnaire was created. The questionnaire was developed in a APACHE web Server, hosted in a DEBIAN LINUX Server. The questionnaire was linked to an SQL data base, comprising as many fields as possible answers. The received answers were dynamically managed via a PHP (Hypertext Pre-processor) program.

As a first step, an electronic mail was sent to all the members of the ADINGOR association explaining the aims of the study and inviting them to participate in it. The questionnaire started to operate in September 2006.

The questionnaire had 15 questions with an estimated answering time of 20 minutes. The questionnaire included both qualitative and quantitative questions and was structured around 5 sections:

- A first section with general data about the respondent and the subjects taught.
- A set of different questions about the characteristics of the applications used.
- Way of using the application (both the students and the instructor).
- Assessment of various aspects (in a 1 to 5 scale)
 - Adaptation to subject contents
 - Time saving due to the use of the application
 - Improvement of the student's professional profile
- Open questions
 - Advantages and disadvantages of using software applications in teaching Engineering Management.
 - Considerations about how software applications can help to the adaptation to the European Higher Education

In the following sections, the main results of the study are presented.

4. Results

4.1 General data about the respondent and the subjects taught

Between September 10th 2006 and October 25th 2006, 19 answers were collected from instructors of 10 different institutions. This represents 67% of the total sample and 53% of the total population. The answers corresponded to 47 different Engineering Management subjects, which have been grouped in 12 categories: quantitative methods and decision making techniques, operations management, industrial statistics, information systems, supply chain management, marketing, industrial organization, human resources management, general management, finance, simulation and project management.

4.2 Kinds of software applications used

Around 30% of answers correspond to applications specifically made for education purposes, 31% to commercial applications used in professional environments (Witness, Microsoft Project, SAP, etc.) and 39% to general purpose applications (Word, Excel, Access, etc.). The cost of the licenses and the additional investments necessary are scarce. In 66% of cases the license is free and in 85% of cases none additional investments are recorded

4.3 Ways of using the application

The applications can be used for different purposes. In 36% of cases, the purpose is to solve exercises in class; in 31% of cases they are used to illustrate theoretical concepts with practical examples; in 29% of cases the idea is to show the student how a real world tool works; finally, just 4% of cases correspond with teaching how to use a specific software in itself. As for the way students can access to the applications, in most cases they are accessed directly in the classroom or lab; in 23% of cases the students are allowed to install the application at home and just a 2% of cases enable remote access (see figure 1).

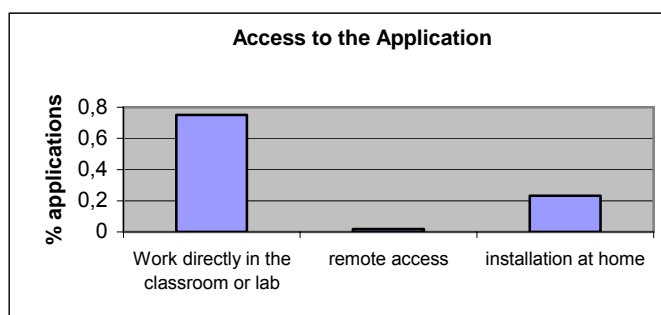


Fig. 1 Ways of accessing the application

The number of working hours outside the classroom using software applications is considerably small. In more than 75% of cases the applications are not used to generate homework at all. As for the time devoted by the instructors, the greatest amount of time is used in preparing the necessary written material (lab guides) with an average of 29 hours in total. The periodic revision of lab material and the assessment of students' homework are of less importance.

4.4 Assessment of different aspects

In this section, respondents were asked to assess a set of different aspects regarding the applications in a 1 to 5 scale. The average values obtained are shown in table 1.

Table 1 Assessment of different aspects

It helps to understand the contents of the subject	3,8
It is useful to illustrate concepts or solve problems that couldn't be solved otherwise	3,5
It helps to save time	2,3
It is easy to use	3,3
It improves the professional profile of the student	3,8

The highest average value (3,8) was given to two aspects: It helps to understand the contents of the subject and It improves the professional profile of the student. The less valued aspect (2,3) was It helps to save time.

4.5 Open questions

As part of the open questions, respondents were asked to explain the advantages and disadvantages of using software applications in Engineering Management education. In most cases, one of the main advantages found is the fact that software applications help the students to improve their professional profile and anticipate to real work situations (seven respondents). Some of these instructors also stress the importance of training abilities and capacities (something that can be done with software applications) as opposed to teaching only concepts.

Another advantage, mentioned by four respondents, are the opportunities for saving time that arise using software applications in Engineering Management education. For example, they save calculation and graphic representation time and permit a more direct focus on core concepts.

Another advantage concerns the improvement of the class dynamics and interactivity. In one of the respondent's own words:

Nowadays, students are more used to learning in a visual and interactive way. Their social environment and new technologies constantly provides them with this kind of information (Internet, cell phones...). I am not sure if these interactions are suitable for the education of an analytical mind, but the truth is that the student is more easily attracted if the instructor uses this new communication codes (diagrams, colours, movement, etc.).

As for the disadvantages, mostly all participants stress the effort needed in order to prepare a suitable lab material. Some of the respondents add the fact that this effort is not given a high value by the national academic quality accreditation agencies (such as ANECA). Some others focus on the high costs and technical issues that are usually involved. In the last place, some comments are made on the possible negative learning effects, such as not achieving a deep knowledge of some techniques and algorithms or relying too much in the applications regardless of the possible modelling lacks.

The instructors were also questioned about the way software applications could help to the adaptation of the Engineering Management degree to the New European Higher Education Area. All respondents except for two agreed that software applications could greatly help to the adaptation, mainly because of two reasons:

- They can make the learning process more flexible and autonomous (especially by using software application to create exercises that the student can conduct at home in a flexible way).

- It helps students to adapt to their future professional environment, by providing a real-world experience and focusing on capacities and abilities as opposed of just theoretical concepts.

5. Conclusions

The study shows how software applications are commonly used in Spanish Engineering Management institutions. There is a variety of applications used (professional, general purpose and specific for education). In an important number of cases the applications are accessed directly in the classroom or lab and just a 2% of cases enable remote access. Not surprisingly, the number of working hours outside the classroom using software applications is considerably small with more than 75% of cases the applications are not used to generate homework at all.

Most respondents are convinced that software applications can contribute to the adaptation of Engineering Management curricula to the European Higher Education Area. They state that software applications can be used to make the learning process more flexible and autonomous. At the same time, they can also provide real world experiences and train certain highly demanded abilities and competences.

One of the main difficulties found is the amount of work necessary in order to develop suitable lab material. At the current moment, this kind of work hardly achieves recognition in the official academic accreditation processes.

In order to fully realize the potential of software applications in the context to the adaptation to the new European Higher Education Area new formulas must be found that enable flexible access to this applications and provide necessary rewards to the trainers that decide to exploit this possibility.

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Reference

- [1] European Union, The European Higher Education Area. Joint declaration of the European Ministers of Education, Convened in Bologna on the 19th of June 1999 (1999). Available on-line: http://www.sc.ehu.es/siwebso/Bolonia/textos/AEES_EHEA/Bologna_declaration.pdf
- [2] González, J. and Wagenaar, R., Tuning Educational Structures in Europe (2003). Universidad de Deusto. Available on-line: http://www.relint.deusto.es/TUNINGProject/spanish/doc_fase1/Tuning%20Educational.pdf
- [3] Moon, Y., Sánchez, T.; Durán, A., A Collaborative ERP Configuration Project: Preparing Engineering Students for the Global Economy, 35th ASEE/IEEE Frontiers in Education Conference, Indianapolis, IN, October 2005.
- [4] González, C.; Arreche, L.; García, A.; Ortega, M., Laboratorio virtual para el diseño y programación de células flexibles de fabricación, X Congreso Nacional de Ingeniería de Organización, Valencia, Septiembre 2006.