

## From a research project to an Information System course: a professional approach

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**Abstract:** Nowadays, new business models are arising thanks to the development of ICT. In this context, the law is constantly being adapted to guarantee the rights of individuals. Studying topics related to legislation without considering its relation with a particular project is unattractive and generally it does not motivate computer science students. However, according to reports by the *Instituto Nacional de Tecnologías de la Comunicación (INTECO)*, a high percentage of Small and Medium Enterprises (SMEs) does not consider current legislation on issues related to ICT. For these reasons, we develop a series of guides defining behaviour protocols, based on an active computer research project oriented to SMEs; and, at the same time, we decided to try to engage computer science students of the need to respect the regulations for the development of any software project (part of their next career future) making clear the relation between their tasks in any project of this kind and the laws and norms that should be respected during this process by the practical use and respect of these laws, in an Information Systems course. This last part is the work we present here.

**Keywords:** project based learning; problem based learning; professional approach; active learning

### Introduction

During the last decades there has been a huge increase in the amount of digitized data available to be processed, thanks to the development of Information and Communications Technology (ICT). This has led to new business models and applications in many areas and sectors. In particular, in the health scope has emerged the area of bioinformatics. According to the definition available in *Wikipedia* (accessed on October the 1<sup>st</sup> 2014), bioinformatics is the application of ICT to the management and analysis of biological data. Furthermore, in recent years, there has been an increase in Small and Medium Enterprises (SMEs), and emerging research groups that thanks to the popularization of biomedical sensors, develop management and processing systems of biomedical signals (signals originated by the human body, used in diagnosis or medical research) with different objectives: improving cognitive development, Escolano et al. (2013), determining the level of stress, Dranca et al. (2013), development of neuromarketing applications, Javor et al. (2013), etc.

At the same time, the development of ICT has generated the need to create and adapt the legislation to guarantee people rights and duties in the context of the so-called Information Society; some concrete examples in the Spanish scope are the *Ley Orgánica 15/1999, de 13 de diciembre, de Protección de Datos de Carácter Personal (LOPD)* and the *Real Decreto 1720/2007, de 21 de diciembre, de aprobación del Reglamento de desarrollo de la LOPD (RLOPD)*. However, according to data provided by the *Instituto Nacional de Tecnologías de la Comunicación (INTECO)*, a high percentage of SMEs are not aware of being subjected to these laws, Pérez San-José et al. (2012), despite of the work that some institutions such as the *Agencia Española de Protección de Datos (AEPD)* have already done.

In this context, we decide to tackle the challenge of the development of an information system to manage data and information from the research project *Identificación de Situaciones de Disminución del Rendimiento del Militar, basado en la Relación de la*

*Variabilidad del Ritmo Cardíaco con el estrés y la Privación de sueño*, Dranca et al. (2013), Peláez Coca (2014) and describe lessons learned during its development.

Starting from this environment, the objective of this work is that the students of Computer Science and Engineering live an experience where they develop an application similar to the ones that they will find in their professional career when they finish their studies. Thus, they have been responsible of specific tasks to be performed within a technological innovation project that is already being developed, with the aim of motivating them in the study of existing legislation on issues related to ICT and Information Systems.

Extracted from the professional reality, the activities were introduced in different sessions of problems and practices in the Information Systems course, with the main objective of helping students to better assume the concepts, the techniques and the technologies used to develop an information system, while involving students of the need to respect the regulations and norms for the development of any software project or information system in general. Moreover, special emphasis was done explaining the concept Normalization. Normalization is the process of developing, implementing and improving the rules that apply to different scientific, industrial or economic activities in order to arrange and improve them. Broadly, the normalization essentially pursues these three objectives:

1. Simplification: to reduce the number of models to work with and to keep only the more necessary information.
2. Unification: to allow international exchange of different methods, concepts and tools.
3. Specification: to avoid errors in identification and interpretation, creating a clear and precise language.

Thus, for the aspects of analysis, design, development, implementation and maintenance of the information system to support CUD2013-11 project, Peláez Coca (2014), we have taken into account the guidelines of the *Asociación Española de Normalización y Certificación* (AENOR) and the standards established by the International Standard Organization (ISO) for the government and the administration of the technologies and information systems. Furthermore, as shown in the different guidelines and standards, we have considered the study of current legislation. So, it is shown to the students in this way.

In the project that concerns us we firstly studied the family of ISO standards 20000 and 27000 (see Figure 1), considering them more relevant than others when starting the development of hardware and software infrastructure to support the information systems required.

The ISO 20000 series deals with aspects related to the management of ICT services and is based on an oriented process to provide users with services that meet the requirements established and a continuous improvement through the PDCA (Plan, Do, Check, Act) model. The ISO 27000 series focuses on information security, that is, the preservation of the confidentiality, integrity and availability of data and information. Security information can also include other properties such as authenticity (assurance that an entity is who it is said to be or that an entity guarantees the source from which the data comes from) and traceability (ensuring that at any time it will be able to determine who did what and when).

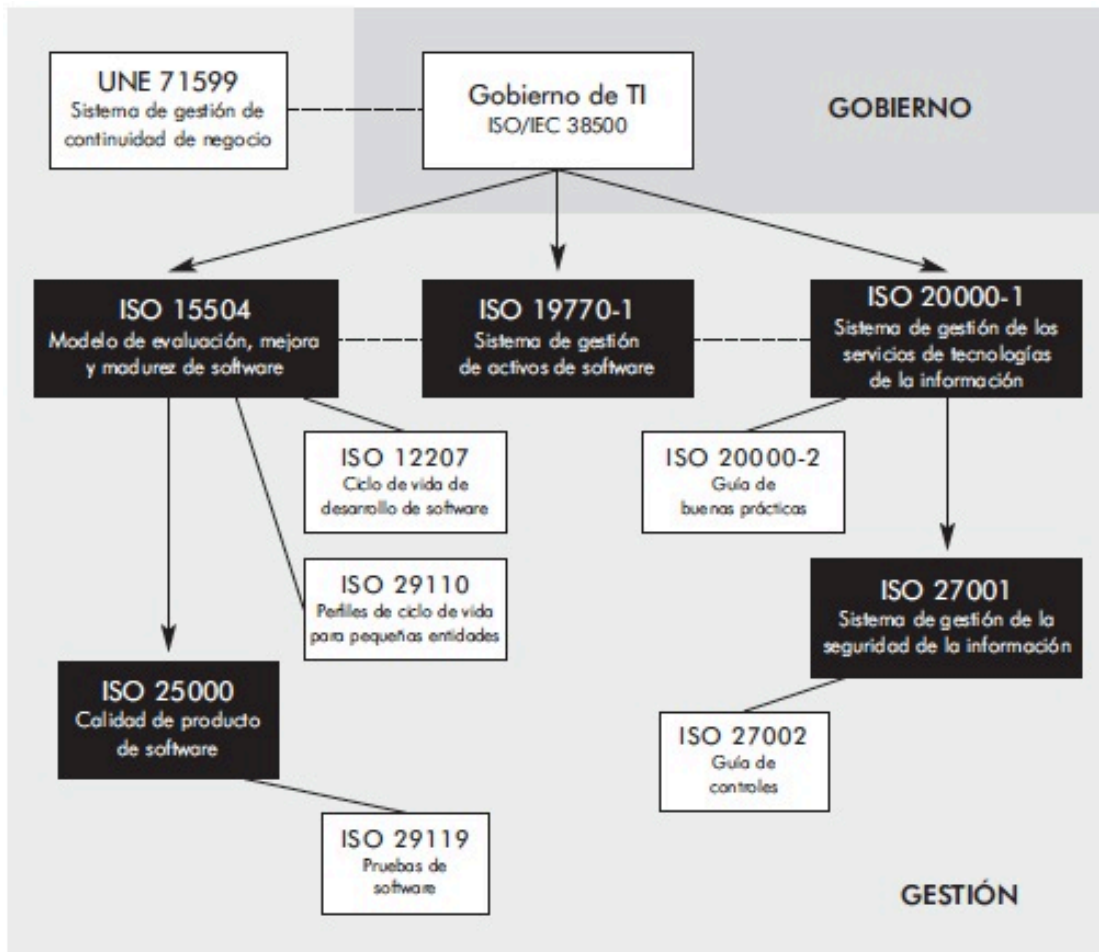


Figure 1. Expanded AENOR model for ICT. Source: Fernández Sánchez and Piattini Velthius (2012)

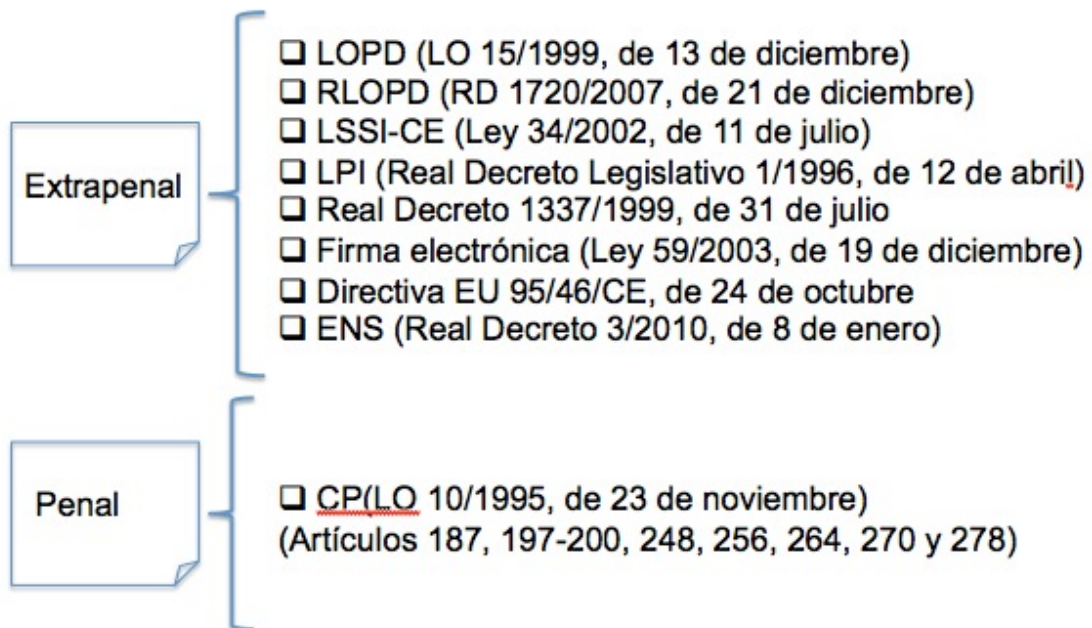


Figure 2. Existing legislation related to Information Systems. Source: Lozano and Trillo-Lado (2014).

Regarding the legislation, the main aspects of the legal framework on the Information Society are considered in relation to the management of safety systems and

technologies of information (see Figure 2). Specifically, we initially focused in the study and analysis of the LOPD and RLOPD. In addition, the current regulations proposal related to data protection in the European Union (EU), European Union (2012) has been taken into account.

## Methods

The target audience of this experience of professional approach are the students of the Information Systems course, which belongs to the Computer Science and Engineering Degree taught at the *Escuela de Ingeniería y Arquitectura, Universidad de Zaragoza*. In general, during the development of practices and problems of the course, students often work with simple examples that do not motivate them. Besides, aspects of legislation in the field of ICT in a Computer Science and Engineering degree do not usually appeal to students. Therefore, in this work we propose that students work and develop their practice in a research project of the *Centro Universitario de la Defensa: Identificación de Situaciones de Disminución del Rendimiento del Militar, basado en la Relación de la Variabilidad del Ritmo Cardíaco con el estrés y la Privación de sueño*, Dranca et al. (2013), Peláez Coca (2014).

The main innovation introduced by this work is, therefore, the use of a real development and technological innovation project, in order to motivate students to study existing legislation and norms on issues related to ICT and Information Systems (Project Based Learning, PBL). Activities are introduced in different kinds of problems and practices of the subject involved. With these activities is intended to get the students close to the professional reality in relation to the subject. The main objective, so, is that this professional experience could help students to better assume the concepts, the techniques, and the technologies used for the development of an information system, from the knowledge and fulfilment of the law, principally, and also the norms.

No set of standards, methodologies and laws can guarantee the full success of the development, implementation and maintenance of an information system. However, considering national and international standards, and the use of standard methodologies, they:

1. facilitate the management of the project (the system does not depend only on the point of view of a particular person),
2. save time (no need to reinvent something already used by others) and
3. facilitate communication among different team members.

Apart from the fulfilment of the law, one of the main ideas to be conveyed to students is that it is necessary to consider the security aspects of the storage, processing and transmission of data and information from the beginning of the project; and not only when implementing and parameterizing specific software.

For the development of this experience the following main activities have been planned:

1. initial development and approach to the foundations of the computer project to approach;
2. based on the previous expertise, designing and setting of the practices and problems to be solved in the classroom, in relation to the various tasks to be performed on the computer project (Problem Based Learning and Project Based Learning);
3. estimating of the workload of the practices assessment proposed to students;

4. development of the practice and problems sessions;
5. evaluating the development of the practices and the final result of them;
6. satisfaction survey designing and evaluation of the activity, to be completed by students;
7. designing of the interviews to be conducted to students of current and previous year;
8. a final evaluation of the experience, so that the strengths and weaknesses of it are obtained, taking into account:
  - survey results
  - information obtained from interviews,
  - as well as comments and opinions of the teachers of the course,
  - and the time taken for the development of this educational project, both by teachers and students.

The students organized themselves in groups of 5 persons to develop a Web application to register, consult and update the information related to the volunteers (patients) of the *Identificación de Situaciones de Disminución del Rendimiento del Militar project*. Moreover, some one-hour seminars to which the groups of students could optionally attend were developed. In more detail, three seminars were held:

- 1) spanish Legislation about personal data: LOPD and RLOPD,
- 2) cloud computing and their implications, and
- 3) methodology to analyze and manage risks: MAGERIT methodology.

After that, the groups of students were asked to write a report where the risks of the Web application that they have previously developed were analyzed. Moreover, some extra time (two weeks) was provided to the students to allow them to improve the implementation of their Web Application.

In relation to the technologies used to develop those activities, several web technologies were explained and proposed to develop the Web Applications: HTML, CSS, Apache-Tomcat, relational and object-relational databases (Oracle, PostgreSQL, Cache, MySQL), middleware mapping object-relational (Hibernate with JPA), Java, JDBC and J2EE. Nevertheless, students could select other technologies and frameworks to develop their information systems. Thus, some of them selected NoSQL database technologies such as MongoDB, scripting languages such as Node.js, etc.

## Results and Discussion

In general, during the development of current practices and problems students often work with simple examples that do not motivate them. Besides, topics related to legislation and ICT in a Computer Science and Engineering degree do not usually appeal to students. So, through this experience students increased their knowledge of the subject, Information Systems, and especially the expertise and know how, as it is a real professional approach that which the students practice with. In addition, they learn it in a more entertaining way, thanks to the motivation of students, because the obtained result is to be applied on a project that is already ongoing. Thus, teachers observed that during the course students were more aware of the need to accomplish with the legal issues than in the previous courses. Moreover, students considered that taking into account the legal issues improved the security and maintenance of their systems.

After the extra time given to the students to refine their systems, the most common improvements of the systems designed and developed by the students that attended the seminars (described in the previous section) were:

- 1) encrypting the passwords of the users of the web application stored in the databases,
- 2) establishing politics to force the users of the Web applications to update their passwords after a period of time, and
- 3) performing backups of the databases of the system.

On the other hand, groups of students who did not attend to the seminars improved the web interfaces of the systems and solved some bugs related to the connections to the databases to allow concurrency. Besides, students who attend to the seminars got better marks in the questions related to legislation issues in the final exams (a test and some short questions).

After the final evaluation results were published, teachers of the subject also interviewed four students (two from the current course and two from the previous one, in order to compare the assimilation of the concepts). The students of the previous year did not remember basic concepts such as the different security levels or the different user roles defined in the LOPD. Besides, they said that legal issues were not important for them and that they did not like them. In contrast, students of the current course claimed that they would like to know more issues related to methodologies and legal issues.

Regarding to sustainability, this experience would be repeated in subsequent years in the same subject, using as a basis new projects that would be useful for the implementation of the tasks that are part of the course, so that it will facilitate the learning of those tasks. Regarding to transferability, the idea of approaching reality through professional learning in a professional development project to an academic degree course could be exported to other related subjects. In fact, it is planned to export this experience to other subjects that the authors would teach in the future.

## **Conclusions**

The feedback provided by the students and teachers involved in this project indicate that legal concepts are better understood when students are involved in a real project. Besides, the results indicate that the students involved in this project obtained higher marks than students that did not participate. Moreover, students were motivated to consider legal issues on their applications, as they appreciated that this leads to improve the security and maintenance of their systems. We think that the main point is that students are motivated due to the relation of the activities they do with something real.

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