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A Systematic Approach to the Pedagogic Design of Final Year Projects: Learning Outcomes, Supervision and Assessment*

RUBÉN FRAILE, IRINA ARGÜELLES, JUAN C. GONZÁLEZ, JUANA M. GUTIÉRREZ-ARRIOLA, JUAN I. GODINO-LLORENTE, CÉSAR BENAVENTE, LUIS ARRIERO and DAVID OSÉS
Escuela Univeristaria de Ingeniería Técnica de Telecomunicación. Universidad Politécnica de Madrid, Carretera de Valencia Km 7. 28031 Madrid, Spain. E-mail: rfraile@ics.upm.es

Final Year Projects (FYPs) are nowadays relevant elements of university studies leading to several kinds of degrees. However, according to literature, most often the educational purposes of FYPs and their assessment procedures and criteria remain unspecified. This fact usually affects student performance and, consequently, it negatively nuances the educational aim of the FYP. Within this paper, the authors report on an effort to define a pedagogic design for final year projects in engineering university studies. This design includes a definition of the expected learning outcomes, a supervision scheme for final year projects and an assessment process. The definition of the expected learning outcomes has been made based on competences. Such a definition has served as a basis for designing a supervision process coherent with the expected educational outcomes. The competence-based definition of the educational outcomes has also been used as a reference for designing the assessment system. Crucial aspects of this systematic approach are the competence-based definition of educational outcomes, the relation among educational outcomes, supervision process and assessment procedure and criteria and the methodology for mark weighting. Nevertheless, the applied methodology allows for easy adaptation of specific aspects to different contexts.

Keywords: final year projects; curricular design; assessment criteria

1. INTRODUCTION

PROJECT-BASED LEARNING [1] is a pedagogical paradigm well recognised for its ability to help students in developing generic skills [2]. In fact, working on a project not only provides students with a framework for applying knowledge that has been acquired along their university courses, but it also helps them to develop a set of additional abilities (higher-order educational objectives, as called in [3]) that are only seldom necessary for passing other subjects. Moreover, it has been reported that project-based learning also improves student satisfaction [4]. For this reasons, final year projects (FYPs) have been for a long time a standard practice in engineering courses [5]. This practice has been extended to other courses during the last decades and student projects now play important roles also in many university courses other than engineering [6]. Furthermore, nowadays, the benefits of project-based learning are trying to be extended in some institutions beyond the framework of FYPs to other previous stages of engineering studies [7] and even as the basic methodology of innovative competence-based learning paradigms [8].

1.1 Unspecified learning outcomes

However, traditionally the key educational content of the FYP (learning outcomes, teaching or supervision method and assessment procedures, as highlighted in [9]) has not often been systematically analysed and, correspondingly, there is a wide variety of approaches for its assessment [10]. As a consequence, students are rarely informed on what they are expected to do and this fact impacts negatively on their performance. For instance, most FYP supervisors consider literature reviews an important part of FYP reports [10], although some studies indicate that the students have difficulties in carrying out these reviews due to the lack of guidelines both on the process itself and on its objectives [11]. Thus, both an explicit statement of learning objectives and a close supervision should help to overcome this kind of problem [6, 12].

1.2 Unspecified evaluation system

In addition to the lack of specification of their learning outcomes, the evaluation systems of FYPs remain usually unspecified [13]. In many cases, this leads not only to obscurity in the criteria, but also to incoherences among evaluators or even among students submitting their works to the same board [14]. These incoherences happen despite some formal aspects for reliable assessment being met (e.g. inclusion of external examiners) [13]. Their numerical impact on student marks has been

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statistically analysed in some specific cases and a statistical correction scheme could be applied to solve the problem [15]. However, it seems reasonable that any sensible proposal of a solution to this problem also includes, at least, a minimal set of common guidelines for assessment [14, 16]. In fact, the sharing of evaluation criteria and forms has proved to increase assessment coherence in other applications of project-based learning [17].

Furthermore, the intrinsic quality (trasparency, coherence, etc.) of both the evaluation process and its results is not the only reason why a well-designed FYP assessment process is desirable. As a matter of fact, the assessment procedure also affects directly the motivation of the students. It is well known that, to a great extent, the most immediate aim of students when working is not usually learning, but attending the demands of the assessment system in order to pass [18]. Thus, the design of the assessment has critical consequences in the way students learn [18] and it should be developed bearing in mind the educational objectives of the FYP [19].

One common approach for the evaluation of FYP is to analyse several aspects of the observable outputs produced by the students during their work, be them either oral presentations, written reports, prototypes or others. For instance, in the case of a written report the statement of project objetives, the literature review, the conclusions, etc. could be analysed independently. Within this bottom-up analysis, each aspect is marked and a weighted combination of marks is subsequently calculated to produce the final mark of the FYP [20]. Automation of mark collection and processing can help in facilitating the implementation of such an assessment process, especially if there are several evaluators [21].

Such an analytical assessment approach has some drawbacks. On the one hand, in its simplest form it is not transparent for the students, since they can be given little feedback related to the specific criteria used by the assessors to mark their work. For example, when a certain mark is given to the conclusions of a report it remains unknown whether that mark corresponds to the content or to formal aspects, i.e. the language. If it corresponds to the content, it is hard to know what is more significant in the reviewer's opinion: the level of abstraction, the logical connection between work and conclusions, the completeness of the conlusions, etc. On the other hand, a detailed breakdown of the assessment, e.g. using rubrics as proposed in [1], would greatly increase the workload of evaluators, hence making the assessment impractical in many cases. Incidentally, rubrics have become widely used for the evaluation of learning projects, to the extent that online tools for their design are now available for public use [22]. An evaluation approach similar to rubrics, but keeping complexity at an affordable level was proposed in [23] with the purpose of improving assessment transparency and having the possibility of giving feedback to students.

1.3 In the light of Bologna

These defficiencies in the specification of the educational aspects of FYPs occur in the context of a process of re-definition of European higher education degrees and curricula that was promoted by the education ministers themselves through the Bologna declaration [24]. During this process, the definition of learning outcomes in terms of competences, as proposed in [25], has been adopted in the development of a common qualification framework [26]. In this context, from the Bologna declaration onwards several efforts have been made to determine which specific competences should be expected as educational outcomes of engineering courses, both at graduate and post-graduate levels [27] [28]. As for FYPs, this impulse towards better quality in higher education by means of competence-based learning paradigms has two consequences: firstly, if a course design is competence-based, then the assessment schemes should be altered coherently so as to make them competence-based too [29] and, secondly, from a quality management point of view, a clear definition of evaluation criteria of FYP should help to identify potential educational deficiencies in University courses [30].

With this situation in mind, in this paper the authors report on an effort to define the expected learning outcomes, a supervision scheme and an assessment system for FYPs in engineering university studies. The definition of the expected learning outcomes was previously detailed in [31], although a simpler approach has finally been preferred. The description of these outcomes is included in Section 2. The detailed breakdown of the educational content of FYPs included in [31] has also served as a basis for designing a FYP supervision process coherent with the educational outcomes. This process is detailed in Section 3. As suggested in [29], the competence-based definition of the educational outcomes is used as a reference for designing the FYP assessment system proposed in Section 4. A discussion on some open issues is included in Section 5 and, last, the main conclusions are summarised in Section 6.

2. EDUCATIONAL OUTCOMES

The definition of the educational objectives of FYPs has been done by relating the experience of the authors in FYP supervision to a selected set of competences drawn from [25] and [28]. A complete description of this definition proposal was included in [31], following a top-down approach in the level of abstraction. Within that approach, learning outcomes were structured in four levels: classes of competences, competences, learning objectives and project achievements. While this structure provided a comprehensive means to relate project activities to learning outcomes expressed in terms of competences, it was too detailed to be manageable by students and lecturers as a guidance for the learning process associated to FYPs. Consequently, only the two levels with the highest degree of abstraction have been considered for the formal definition of learning outcomes: classes of competences and competences. In the following paragraphs, the four classes comprising 11 relevant competences for FYPs are specified. For the sake of clarity, the whole specification starts with the definition of FYP and competence:

- Final year project: an original work carried out by the student immediately before his or her graduation that is presented to and evaluated by an examination board and that consists in either:
  (1) an integral project aimed at the implementation of a real system, within the extent of the specific field of the graduation course, that comprises the main competences developed during such course or
  (2) an innovative work that consists in the development of an idea, prototype or model related to the field of knowledge of the graduation course.
- Competence: the set of knowledge, skills and attitudes that makes a person capable of performing well on a certain activity or group of activities.

As highlighted in [31], only competences directly related to the FYP have been selected, thus leaving aside other competences that, while being relevant for engineering activities, are usually more directly related to other moments of the university courses:

2.1 Intellectual competences

These are related to the way reality is analysed, reasoning on it is produced and proposals to change it are generated.

- C-I. Competence for analysing and synthesizing: capacity for compiling, comprehending, interpreting and evaluating information and data relative to a technological problem in such a way that its main aspects can be easily identified.
- C-II. Competence for applying knowledge to practice: capacity for solving specific problems making use of the specific knowledge of the correspondent technology and conceiving, if needed, new systems or devices that help achieving the objectives and requirements of the undertaken problem.
- C-III. Competence for making research: capacity for generating new knowledge from hypothesis and data making use of the scientific method.
- C-IV. Competence for scientific and rational analysis: attitude for systematically analysing reality from a rational-scientific point of view, which is characterised by the appropriate use of theories and models, the production of coherent interpretations of facts, the critical analysis and the forming of personal opinions and judgements.

2.2 Instrumental competences

Instrumental competences are related to knowledge, techniques and working procedures that must have been acquired before the beginning of the FYP.

- C-V. Competence for dealing with the basic knowledge of the technological area: familiarity with the basic concepts of the correspondent knowledge and technological area and capacity to increase the personal knowledge through autonomous study.
- C-VI. Competence for managing information: capacity for finding information in bibliographies, distinguishing between primary and secondary bibliographic sources, making good use of libraries and locating information on the World Wide Web assessing its reliability.
- C-VII. Competence for performing basic tasks with computers: capacity for creating and storing information in several formats, for complying with norms relative to those formats, for communicating making use of computer networking, for using online resources, for registering experimental data in electronic format and for using software specific to the correspondent knowledge area.
- C-VIII. Competence for language communication: capacity for elaborating written texts and oral dissertations following orthographic and grammatical rules, with a coherent ordering of ideas and arguments and with different levels of detail; having good fluency in a second language, at least in reading comprehension.

2.3 Managerial competences

These competences are related to the planning and implementation of activities, either individual or in group.

- C-IX. Competence for inter-personal relations: capacity for listening to other opinions and views, for using verbal and non-verbal codes, for working in a team and, if necessary, leading it, for presenting proposals and projects, for debating, for conducting interviews, for generating interactive environments, for interacting with people coming from diverse social and cultural contexts.
- C-X. Competence for task managing: capacity for organising time, for setting priorities, for working under pressure, for complying with compromises in results and time.

2.4 Social contextualisation competence

This is related to analysing and previewing the interaction between technology and the social context in which it takes place.

- C-XI. Competence for analysing the social context: consciousness of the existence and the origin of social conditions, restrictions, beliefs and usages and capacity for assessing the social and ethical impact of technological projects.

As stated before, the educational purposes of the FYP could be further concretised. However, in the authors' view, this level is enough both to inform students on what they are expected to do and to design a competence-based FYP assessment system, as proposed in Section 4.

3. SUPERVISION

The supervision process of FYPs has been designed considering some aspects commented on in Section 1 and the specific project achievements and tasks enumerated in [31]. The most relevant aspects of the proposal are as follows:

- It provides the students with specifications about the expected educational outcomes of their work, as proposed in [6] and [12];
- It allows the supervisor to perform guidance and assessment based on competences, as suggested in [29];
- An e-learning platform is used for the submission of documents, publication of relevant dates and other issues, sharing of ideas, etc. This should contribute to the achievement of competences C-VI and C-VII;
- Times for interchange of ideas and discussion are scheduled, hence contributing to the development of competences C-VIII and C-IX;
- A project plan is requested at the first stages of the project, thus creating appropriate conditions for the progress in competence C-X.

These aspects are concretised in the following elements of the supervision process:

3.1. Student's guide to the FYP.

The first element of the supervision process is the edition of a student's guide to the FYP. Delivering a printed version of this guide to the students is aimed at providing them with indications on the educational content, administrative procedures, assessment process and formal requirements of the FYP. In the case of the authors' institution, a student's guide has been edited with the following contents:

- Basic information: Faculty, department, number of credits assigned to the FYP, etc.
- Project supervisor: Name, e-mail address and other data.
- Educational purpose of the FYP: including the general aim and the eleven associated competences.
- Description of project types: research, design, performed in private companies, etc.
- Role of supervisor and student's responsibilities.
- Administrative procedures.
- Formal requirements for the final report.
- Recommendations for the oral presentation.
- Assessment system and criteria, including copies of the specific forms to be filled in by the evaluators.
- Reference norms: literal text of the Faculty's norms relative to FYPs.

3.2 Virtual space for sharing resources and experiences with colleagues and supervisors

In order to give the students further guidance, the student's guide together with additional information and recommendations can be made accessible through an e-learning platform. This choice has the additional benefits of encouraging the use of this kind of tool, getting the students accustomed to making use of online resources, serving as a communication means between student and supervisor, even for the submission of documents, and promoting interchange of ideas and comments among students through online fora. The authors have designed a prototype of such virtual space using the platform Moodle [32]. The central contents of the main FYP webpage are depicted in Fig. 1. They include:

- General aspects of FYP: including the student's guide in electronic version, a forum for organisational news and another one for student's use.
- Documentation related to the FYP.
- Submissions: project plan, FYP final report and slides for the oral presentation.
- Guidelines: additional guidelines for preparing the required submissions.
- Required documents.

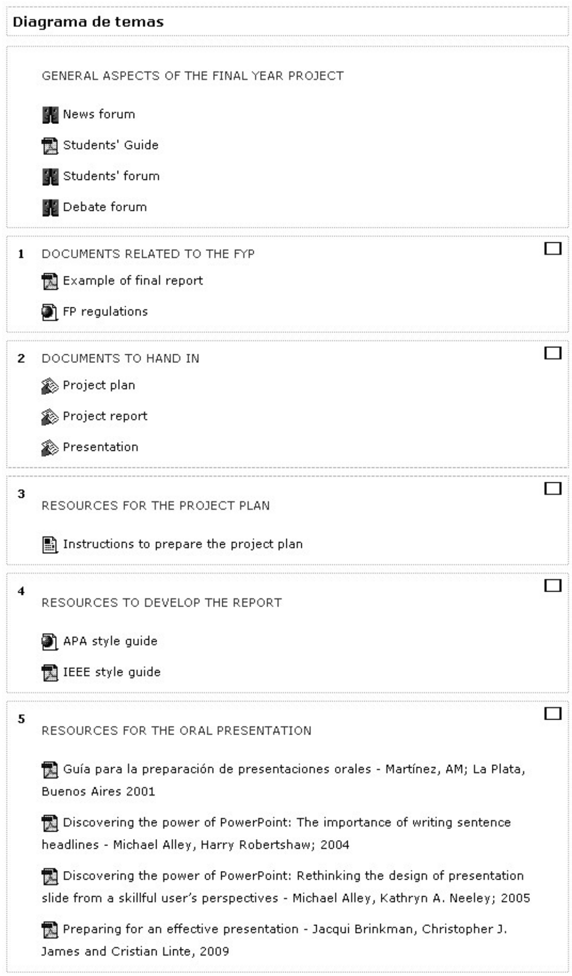

Fig. 1. Main part of the Moodle web space for the FYP.

As mentioned in the previous section, within this proposal the students are required to submit three documents in the course of their projects. The submission of a final report is a standard in any kind of project and, in this case, as is usual, it will be an essential element for the evaluation of FYPs. Additionally, the submission of a project plan after the first weeks of work has the purpose of both helping students in growing competence C-X (competence for task managing) and, at the same time, serving as a reference for the supervisor to assess the accomplishment of project objectives. Last, the submission of the slides for the oral presentation is optional in the sense that this material is later evaluated as part of the oral presentation itself, but giving the students this chance should help them to obtain previous informal assessment and comments from either their supervisors or their colleagues.

3.3 Group meetings

While in essence the FYP is an individual work that allows each student to conclude his or her university course without depending on the work of his or her colleagues, it is also true that a relevant competence of university graduates is their ability to communicate and discuss technical or scientific issues. In order to account for this, the supervision proposal includes three group meetings. Depending on the institution, the group can be chosen to be formed by all the FYP students of the same department, division, faculty, etc. Actually, the objective of the first meeting is quite different, since it is intended to be a formal launch of the projects and an opportunity for the students to meet and to know about the topics of the FYPs of their colleagues. The second meeting would take place after the submission of the project plans and it would have a significant scientific-technical content consisting in each student providing the rest with an overview of his or her work and approaches. Last, the final oral presentation of the project is proposed to have the same format, hence promoting discussion among students.

3.4 Individual meetings with supervisor

The last element of the supervision process is a series of individual meetings between student and supervisor. These meetings have the objective of guiding the work of the students, solving doubts and giving feedback on their performance. A frequency of at least one meeting every two weeks is desirable, in the authors' view.

4. EVALUATION

4.1 Assessment procedure

As stated in Section 1, the student evaluation in a competence-based learning paradigm should be competence-based too [29]. Therefore, the herein proposed procedure for FYP assessment consists in directly evaluating up to which level the student has acquired each of the 11 competences involved in FYPs. In this way, the students' attention is not deviated towards specific aspects whose artificially increased relevance could bias the overall educational aim and, at the same time, the coherence between FYP educational objectives and assessment process is kept.

However, the diversity of competences to be evaluated results in a corresponding diversity of evaluation times and people involved. Considering both common practice and the supervision scheme described in Section 3, at least three evaluation moments and agents can be identified:

(1) Implementation process: the work of each student can be assessed continuously by the FYP supervisor during group and individual meetings and also when considering the project plan and the contributions sent to the FYP virtual space.
(2) Final report: evaluated by a board formed by lecturers.
(3) Oral presentation: also evaluated by a board of lecturers with possible inclusion of colleague students.

Table 1 summarises the authors' view on which competences can be evaluated in each of the three above-mentioned moments. A detailed justification for this relation between competences and moments can be found in [31]. From this table, it becomes clear that the three evaluation moments are complementary in the sense that none of them can account for all the competences. Moreover, according to the same table, the evaluation board

Table 1. Competences and evaluation moments

Competence	Impl.	Rep.	Pres.
C-I Analysing and synthesizing	X	X	
C-II Applying knowledge to practice	X	X	
C-III Making research	X	X	
C-IV Scientific and rational analysis	X	X	X
C-V . . . knowledge of the technological area	X	X	X
C-VI Managing information	X	X	
C-VII Performing basic tasks with computers	X	X	X
C-VIII Language Communications		X	X
C-IX Inter-personal relations	X		X
C-X Task managing	X		
C-XI Analysing the social context	X	X	X

needs at least two of these views of the project to have a complete overview of it.

The acquisition of each one of the eleven competences by the student is observable in different ways depending on the evaluation moment. For instance, the competence for analysing and synthesising, with respect to the final report, it should result in producing a good problem description and decomposition into sub-problems; in contrast, the FYP supervisor can assess the competence acquisition by the way the student has proceeded in approaching the work. In order to ease the particularisation of each competence to each evaluation moment and also to provide a common guideline for all evaluators, the authors propose to use a set of three different questionnaires for the evaluation at each of the three moments. Sample questionnaires are included as tables in the appendix.

Regarding the issue of how to combine the marks given to produce a final mark for each competence, a variety of possible procedures exists, but the authors propose a consensus among the evaluators built in a private meeting after the oral presentation.

4.2 Competence ranking and weighting

A second question that arises in the design of the evaluation process when a final numeric mark has to be assigned to the FYP of a student is how to rank the competences and how to weight the marks given to each one in order to obtain a global mark. For solving this question, the authors have followed a two-stage procedure inspired by [33]:

- As a first step, each author has ordered the 11 competences by their relevance for FYPs.
- Secondly, a weight has been assigned to each competence relative to the following one in the ordered list. After that, a simple set of linear equations has allowed these weightings to be converted into a set summing 100%.
- These two steps have been taken independently by each author, without knowing the proposals of the rest. Averaging the resulting weights results in the list of relative relevances of competences included in Table 2.

Beyond the specific results shown in this list, which obviously are prone to variations depending on the specific group of people involved in its elaboration, the following aspects can be highlighted:

- All authors except for one agree that competences C-II and C-V are among the four most relevant.
- All authors except for one agree that competence C-VIII has a medium relevance.
- All authors except for one agree that competence C-III is among the four least relevant.
- All authors agree that competence C-XI is among the three least relevant.

Regarding this analysis, it should be recalled that the issue being studied here is the relevance of each competence in the educational contents and assessment process of FYPs in an engineering course, not the importance of each competence either in professional life or in other contexts. For instance, being competent in performing tasks with computers is undoubtedly very relevant for engineers, but such competence should be developed mainly before reaching the FYP. Conversely, while certain research tasks can be developed during the FYP, the competence for making research is more closely related to higher educational levels (e.g. doctorate).

5. DISCUSSION

Within this paper, the authors have presented an overview of a pedagogic design of FYPs in engineering university studies. This design includes a definition of the expected learning outcomes, a FYP supervision scheme and an assessment process, which are key elements in the design of educational activities in nowadays university courses [9]. While the details of the proposal may be somewhat biased by the professional background of the authors (six engineers, one physicist and one linguist, all giving lectures in a Telecommunications Engineering faculty) and the specifics of their institution, the approach can be easily transferred to other contexts, as reasoned in the next paragraphs.

Educational outcomes have been defined in terms of competences, which is a nowadays standard for the design of university courses (see Section 1). The specific selection of competences related to the FYP has been based both on the authors'

Table 2. Relative relevance of competences

Rank	Competence	Weight
1st	C-V Dealing with the basic knowledge of the technological area	15%
2nd	C-II Applying knowledge to practice	14%
3rd	C-I Analysing and synthesizing	13%
4th	C-VI Managing information	11%
5th	C-X Task managing	9%
6th	C-IV Scientific and rational analysis	9%
7th	C-VIII Language communication	8%
8th	C-IX Inter-personal relations	7%
9th	C-VII Performing basic tasks with computers	6%
10th	C-III Making research	4%
11th	C-XI Analysing the social context	4%

practice and on the freely accessible documents [25] and [28]. While [25] was made from experiences and investigations drawn from courses other than engineering [28] was made specifically for engineering but without any restriction in the engineering subject. Therefore, although the particular choice of educational outcomes may vary depending on the countries, institutions and departments, the proposal presented here is generic enough to cover a wide range of circumstances.

The proposed supervision scheme has been designed mainly from authors' experience. However, according to references cited in Section 1, this experience is coherent with that of many other lecturers. Such general coherence can easily be detected among many bibliographic references (e.g. [6, 10, 13, 14], etc.). Besides, the proposed supervision scheme has clear connections with the defined educational outcomes of FYPs, as justified in the beginning of Section 3 and detailed in [31]. Therefore, although some aspects of it could be changed or adapted from one case to another, the two essential elements of the proposal are the relation to the expected FYP outcomes and the links to the past experience of university lecturers throughout the world.

The specific definition proposed for the evaluation process may be seen as the weakest part of the proposal, since it highly depends on the personal views of the authors. However, two parts should be clearly differentiated whithin this proposal: the assessment procedure and the assignment of a final mark to the FYP. The assessment procedure is closely related to the proposed supervision scheme and it follows the rule of directly assessing the relevant educational outcomes, namely the competences, as suggested in [29]. These two criteria, together with the search for simple questionnaires that can be contained within a single sheet of paper, have served as a basis for the proposal.

As for the assignment of marks to each competence, although the proposal allows certain degree of subjectivity, it could be complemented with a rubric-type guide for evaluation. It should also be noted that, intentionally, no predefined scale for the marks has been given. In the authors' view, this is not a critical aspect of the proposal and it can be adapted to specific circumstances. Still, if an objective orientation were to be given, a scale consisting of four to five levels seems to be appropriate, according to [1] and [22].

Regarding the ranking and weighting of competences, the ordered list presented in Table 1 is undoubtedly a result of the personal views of the authors. Yet, some aspects of the proposal can be generalised. In the first place, the two-stage approach (ranking in the first place, weighting in the second place) derived as a simplification of the proposal in [33] can be adopted within any group to identify the most and least relevant competences. In the second place, it is also significant that, after an independent ranking-and-weighting process, there was a remarkable degree of agreement in that the knowledge of the technological area and the capacity of applying theory to practice are the most relevant competences to be developed and assessed during the FYP, in that making research and analysing the social context are among the least relevant and in that the relevance of language communication should not be diminished.

Finally, the whole approach for the educational design of FYPs could easily be extended to the final works in higher educational levels (e.g. MSc or Ph.D.). As considered in [28], the set of competences to be developed at graduate and postgraduate levels is mainly the same, though the particularisation of those competences for each educational level should result in different educational objectives. As for the supervision and evaluation processes, they could remain basically unchanged but with different weights assigned to each competence, since the purpose of postgraduate studies is not the same as that of undergraduate courses.

6. CONCLUSIONS

In this paper, the authors have presented a systematic approach to the definition of the key pedagogic elements of final year projects: learning outcomes, supervision process and evaluation. The systematic approach has consisted in, firstly, defining learning outcomes of FYPs based on current freely available standards and on FYP supervision experience, both that of the authors and that reported in literature. Secondly, the proposed FYP supervision process has been linked to the previously defined learning outcomes, with each element contributing to those outcomes. Last, an evaluation procedure has been outlined that has the property of assessing learning outcomes directly. Moreover, a procedure has been also proposed for weighting learning outcomes so as to produce a final mark for the FYP.

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APPENDIX: EVALUATION QUESTIONNAIRES

Table 3. Questionnaire for evaluation of implementation process

Competence	Mark
C-I Analysing and synthesizing: *The student has understood the proposed problem and all its conditions and circumstances. He or she has been autonomous in critically searching, gathering and processing information. He or she has succeeded in relating the problem to others previously approached.*	
C-II Applying knowledge to practice: *The student has been autonomous in applying scientific knowledge and he or she has proposed well founded hypothesis and methods. Changes in methods and objectives have been well reasoned. Required time and equipment resources have been defined beforehand.*	
C-III Making research: *The student has shown ability to approach problems at different levels of abstraction, to design experiments, to process data using appropriate statistical and mathematical tools, to handle specific instrumentation and to interpret results.*	
C-IV Scientific and rational analysis: *The student has identified all the different parts of the problem. He or she has presented and defended arguments in discussions with the supervisor and with other students. He or she has decided based on objective criteria and has used multidisciplinary knowledge when needed.*	
C-V . . . knowledge of the technological area: *The student has shown to be competent in dealing with procedures and concepts of his or her knowledge area and also in handling specific instrumentation. He or she has been autonomous in looking for information that helped in solving his or her doubts.*	
C-VI Managing information: *The student has been autonomous in gathering and selecting information. He or she has resorted to several sources of information and has been able to assess the reliability of each one. He or she has made use of on-line resources provided by the university.*	
C-VII Performing basic tasks with computers: *The student is skilled in managing diverse data and document formats, he or she has usually accessed to telematic resources and services and has appropriately used data processing software and also software specific to his or her knowledge area.*	
C-IX Inter-personal relations: *The student has regularly attended to meetings with the supervisor and has been able both to discuss and defend his or her approaches and to rectify them when needed. He or she has shared ideas with colleagues and, if required, he or she has participated in joint projects and coordinated part of the work.*	
C-X Task managing: *The student has written a project plan, kept a log book of the project activities, respected foreseen deadlines and activities and adjusted the plan when needed.*	
C-XI Analysing the social context: *The student has evaluated results bearing in mind their applicability. He or she has included ethical and social issues in the context analysis.*	

Table 4. Questionnaire for evaluation of final report

Competence	Mark
C-I Analysing and synthesizing: *Problem description and analysis are based on a sufficiently wide up-to-date specific bibliography. The literature review has clearly synthesised contents, it is well structured and it includes a judicious analysis of the bibliography while avoiding plagiarism. The hypothesis and/or design criteria are clearly linked to the review of the state of the art. Data collected during the project have been adequately organised and analysed and they provide a clear foundation for the conclusions.*	
C-II Applying knowledge to practice: *Project hypothesis and objectives are clearly stated, well founded on theoretical knowledge and realistic. Project objectives are original and result from a personal contribution of the student. The proposed methodology is coherent with the objectives, it is clearly explained and justified and it leads to the reported results.*	
C-III Making research: *Unsolved issues have been identified and corresponding hypothesis have been estated. Experiments and results have been adequately carried out and collected in order to confirm or reject such hypothesis. Data analysis has been unbiased and it clearly supports the conclusions. Findings and conclusions have been discussed and contrasted to previous results present in literature.*	
C-IV Scientific and rational analysis: *The contents of the final a report are well organised. The approach to the project is systematic. Statements and interpretations are correctly reasoned or founded in adequate bibliography.*	
C-V . . . knowledge of the technological area: *Project implementation has involved knowledge related to the University course, and part of it has required autonomous study by the student. Conceptual errors have been avoided and, if needed, specific instrumentation has been correctly used and its specifications and using requirements have been reported.*	
C-VI Managing information: *The final report includes a list of references. All references have been cited in the text. Reference format is as specified. Sources of all copied material have been cited.*	
C-VII Performing basic tasks with computers: *The format specifications of the document have been respected. Usage of styles and formats is coherent throughout the whole document. Appropriate software has been used for generation of graphics and data processing.*	
C-VIII Language communication: *The structure of the report is correct. Headings and content are coherent. Both repetitions and ambiguities are avoided. The text is clear and concise. The length of the final report is adequate for its contents and it does not contain either syntactic, ortographic or semantic errors. The bibliography is multilingual.*	
C-XI Analysing the social context: *The project context is mentioned and described. Both practical and ethical consequences of the project have been considered.*	

Table 5. Questionnaire for evaluation of oral presentation

Competence	Mark
C-IV Scientific and rational analysis: *The student has presented his or her work in a well structured way. He or she has adequately justified his or her decisions, proposals and answers.*	
C-V . . . knowledge of the technological area: *The student has shown good knowledge of the subject in which the project is framed. He or she has used specific vocabulary properly and avoided superficial analyses.*	
C-VII Performing basic tasks with computers: *The student has adequately used supporting software for the presentation, shown well elaborated graphs and, if needed, performed software demonstrations.*	
C-VIII Language communication: *The structure of the presentation has been appropriate. Repetitions and ambiguities have been avoided. The language has been clear and concise and using appropriate vocabulary and register. The presentation length has been adapted to its contents.*	
C-IX Inter-personal relations: *The student has succeded in maintaining the attention of the audience. He or she has answered all questions without avoiding any and recognised own mistakes. His or her position in the room and speech loudness and speed have also been appropriate. Reading has been avoided.*	
C-XI Analysing the social context: *The student has spoken about the social context and relevance of the work. Topics and superficial approaches in analysisng ethical issues have been avoided. He or she has shown sensitivity towards the social impact of the project.*	

Rubén Fraile, graduated in Telecommunication Engineering in 1995 at the Universidad Politécnica de Valencia (UPV) in Spain, where he also obtained the Ph.D. in 2000. He has worked as a research fellow in the UPV and as a radio planner in Retevisión Movil (Spanish GSM operator). From 2000 to 2006, he taught technology and computing in a secondary school and gave lectures in MSc and PhD programmes of the UPV. In 2007 he joined the Circuits and Systems Engineering Department of the Universidad Politécnica de Madrid and, from then, he has given lectures both at graduate and postgraduate levels.

Irina Argüelles has a Ph.D. in English Philology. She is a Senior Lecturer of the Department of Linguistics Applied to Science and Technology of the Universidad Politécnica de Madrid. She gives lectures in Technical and Professional English to undergraduate students and participates in the lecturing of a doctorate course on Linguistics and Didactics of Speciality Texts. Her research work has been focused on the evaluation of writing and reading skills, innovation in didactic methodology and integration of ICT into English lectures. From 2006, she has participated in seven research projects in educational innovation.

Juan C. González graduated in Physics in 1987 at the Universidad Autónoma de Madrid in Spain and he obtained the Ph.D. in 1994 at the Universidad Complutense de Madrid. He has researched on optical properties of semiconductor, optical properties of nanostructured materials and nonlinear optics. He joined the Circuits and Systems Engineering Department of the Universidad Politécnica de Madrid in October 1996 and, from then, he has given lectures both at graduate and postgraduate levels.

Juana M. Gutiérrez-Arriola received her MSc degree on Telecommunications Engineering from Universidad de Cantabria in 1994 and her PhD. degree from Universidad Politécnica de Madrid in 2008. She has been teaching first and second year undergraduate courses since 1998. She has participated in several Educative Innovation Projects and has coordinated the implementation of the Bologna Process in second year undergraduate studies. Currently she is lectures at the department of Circuits and Systems Engineering at the Universidad Politécnica de Madrid.

Juan I. Godino-Llorente received the MSc in Telecommunications Engineering in 1996 and the PhD degree with honors in Computer Science from the Universidad Politécnica de Madrid, Spain, in 2002. Currently he is an Senior Lecturer at the Universidad Politécnica de Madrid. He teaches both at graduate and postgraduate levels within the Circuits and Systems Engineering Department, which belongs to the same University. His main research areas are in the field of biomedical signal processing, with applications to voice disorders and ECG signal processing.

César Benavente obtained the Ph.D. degree in 1999 from the Universidad Politécnica de Madrid. Since 1991 he has been with the Circuits and Systems engineering Department at the Telecommunications School in the Campus Sur . His teaching activity is related to signals and systems theory and digital signal processing. He is a member of an innovation in

education group related to signal theory and digital signal processing. His research interests are those concerning digital signal processing in communication systems, MIMO systems, location systems and wireless networks.

Luis Arriero received the MSc in Telecommunications Engineering at the Universidad Politécnica de Madrid in 1999 and he is currently working toward the Ph.D. degree at the same university, where he also gives lectures within the Circuits and Systems Engineering Department. He lectures Signal and Systems and Digital Signal Processing. His research interests include algorithm for SVD computation in MIMO system, modelling of non-linear amplifiers. He is also active in continuing assessment and education activities.

David Osés received the MSc in Telecommunications Engineering from Universidad Politécnica de Madrid in 1996 and the Ph.D. degree from Universidad de Alcalá in 2001. He is currently a Senior Lecturer at the Universidad Politécnica de Madrid, where he is the Head of the Circuits and Systems Engineering Department and has been visiting professor at the Universidad de Alcalá. He gives lectures in Signal and Systems and Digital Signal Processing. His research interest includes filter banks and finite-wordlength effects in digital filters. He is also active in continuing assessment and education activities.