

Evaluation and assessment of professional skills in the Final Year Project

Fermín Sánchez, Joan Climent, Julita Corbalán, Pau Fonseca, Jordi García, José R. Herrero, Xavier Llinàs, Horacio Rodríguez, Maria-Ribera Sancho, Marc Alier, Jose Cabré and David López

Facultat d'Informàtica de Barcelona / Barcelona School of Informatics
Universitat Politècnica de Catalunya - BarcelonaTech
Barcelona, Spain

fermin@ac.upc.edu, juan.climent@upc.edu, juli@ac.upc.edu, pau@fib.upc.edu, jordig@ac.upc.edu, josepr@ac.upc.edu, xavier.llinas@upc.edu, horacio@lsi.upc.edu, ribera@essi.upc.edu, granludo@essi.upc.edu, jose.cabre@upc.edu, david@ac.upc.edu

Abstract— In this paper, we present a methodology for Final Year Project (FYP) monitoring and assessment that considers the inclusion of the professional skills required in the particular engineering degree. This proper monitoring and clear evaluation framework provides the student with valuable support for the project implementation as well as for improving the quality of the projects, thereby reducing the academic drop-out rate. The proposed methodology has been implemented at the Barcelona School of Informatics at the Universitat Politècnica de Catalunya - BarcelonaTech. The FYP is structured around three milestones: project definition, project monitoring and project completion. Skills are assigned to each milestone according to the tasks required in that phase, and a list of indicators is defined for each phase. The evaluation criteria for each indicator at each phase are specified in a rubric, and are made public both to students and teachers. Thus, the FYP includes an exhaustive evaluation method distributed throughout the whole project implementation, thereby facilitating project organization for the student as well as providing a clear and homogeneous assessment framework. The methodology for the FYP organization, assessment and evaluation was launched and piloted over two semesters. We believe the experience to be general in the sense that it has been conducted as part of an ICT engineering degree, but may easily be extended to any other engineering degree.

Keywords— *Final Year Project, evaluation of FYP, evaluation of professional skills.*

I. INTRODUCTION

The first Final Year Projects (FYPs) under the EHEA (European Higher Education Area) environment were initially introduced in Spanish undergraduate degrees in 2012-2013. The Dissertation should be evaluated in a different way to how the FYPs have been evaluated to date.

The evaluation of the former FYPs considered specific and professional skills jointly. For example, the oral and written expression were evaluated in all projects, although usually not explicitly or according to a unified criterion. In general, the former FYPs were evaluated by a committee formed by several professors, among whom the director may or may not have been included. The evaluation was based on a report and

a public presentation of the project. The report and the work of the student have normally been supervised by the director of the project, and the committee generally evaluates the technical quality of the project, the quality of the written report and the quality of the oral presentation. These three aspects are usually evaluated together and give rise to a single grade, which is the final grade of the FYP.

Most centers do not provide students with documentation detailing what form the project report, the presentation or the technical content should take. These aspects are usually left to the discretion of the project director, whose task is to correct any shortcomings when students are doing the FYP. This means that, in the majority of cases, the grade for the project depends not only on the quality of the project itself, but also on the committee evaluating it and the experience of the project director. Different committees may award give different grades to the same project, since the evaluation criteria are not explicitly defined.

In the new FYPs, on the other hand, specific and the professional skills should be assessed explicitly. Instead of a single final grade, as in the case of the former FYPs, a new FYP rating should be generated from a set of notes on the different skills to be addressed. In order to solve the problem of arbitrariness detected in the evaluation of former FYPs, clear criteria should be established for the evaluation of each of the skills in such a way that traceability exists. In addition, the publication of these criteria will serve to guide the student in the execution and documentation of his or her FYP.

For this purpose, between 2008 and 2009 the Ministry of Science and Innovation and the Quality Agency of the Catalonia University System financed the project "Guidelines to the evaluation of competences in the Bachelor and Master Degree thesis in engineering" [1]. This work was presented at FIE in 2009 [2]. It is in fact a guide for each Center to define its own procedure for FYP evaluation. The following section briefly describes the main ideas of the Guide.

The rest of the paper is organized as follows: in Section II we present some related work; Section III summarizes the guide; Section IV describes our environment; Section V

presents the subject Project Management; Section VI explains the evaluation milestones and the indicators used to evaluate the FYP; Section VII details the final assessment; Section VIII comments the guidelines for the students, and Section IX concludes the paper.

II. RELATED WORK

Professional skills in computer science were introduced at the beginning of the Bologna process [3]. Between 1999 and 2010, all the efforts of the Bologna Process members were aimed at creating the EHEA [4], which became a reality with the Budapest-Vienna Declaration of March, 2010. The main ministerial statements and guidelines for consolidating this process can be found in [5]. In Spain, the Minister of Science and Education (MEC) specifies that official degrees must have a professional orientation, and professional skills must be integrated and mentioned in the diploma.

Based on the work done by Valderrama et al. in [2], which defines between 4 and 6 stages for assessment, other authors have developed their own proposals. In [6], Sanchez et al. present a proposal for the evaluation of professional skills in the Final Year Project as a recommendation for the Universidad de La Laguna. This particular proposal refers to no specific course related to project development and assigns 28% of the grade to professional skills. These authors also propose that evidence should be gathered by the supervisor, while leaving the final score to the evaluation panel on the day of the presentation. In our work, we explicitly assign weights for the different milestones, while in the aforementioned work the authors also use a four-level compliance for competence evaluation. Although we also use four levels, they differ slightly insofar as they use *Pass* as the second level. It should be pointed out that [6] consists of a set of recommendations, while our work is much more specific in that it consists of a real implementation.

In [7], Fraile et al. also put forward a proposal for the evaluation of the FYP, in this case for the Universidad Politécnica de Madrid. The proposal set out by these authors is similar in essence but considers a different implementation. It also consists of three milestones, two of them being the final report and the oral presentation, which in our work are considered together in the Final assessment. They also differ in details such as the assigning of numerical grades to skills, while we assign four levels of compliance to the indicators.

The use of rubrics has been extensively adopted in evaluation [8, 9, 10, 11, 12]. All these works propose the use of rubrics for assessment, defining 3 or 4 levels of compliance. In [8] the authors comment on the problem of providing rubrics to students, which may result in a list of minimum requirements that should be met by students. In our proposal we also provide a list of questions to be considered by students as a guide.

In [13], M.A. Sicilia discusses the introduction of Transversal (professional) Competences, TC, in Computing curricula and its assessment. This author points out that the criteria for

including a TC can be established as follows: i) defining what the important TCs are for a given graduate profile, ii) In what courses can these TCs be introduced?, iii) how and when should TCs be evaluated?, and iv) what role and level of importance should be given to these TCs in the design of the curriculum? As source information for defining the TC, Sicilia uses SWEBOK, [14]. SWEBOK (Software Engineering Body of Knowledge) is an international standard ISO/IEC TR 19759:2005 specifying a guide to the generally accepted Software Engineering Body of Knowledge. Clearly, a crucial point is the assessment of TC, i.e. determining the approach, metrics, and instruments for assessment, as well as the appropriate milestones for performing the evaluation tasks.

Another important issue is the way in which professional skills are integrated into the curriculum and how they are evaluated. The ITiCSE'99 Working Group on Integrating Professionalism and Workplace Issues into the Computing and Information Technology Curriculum [15] points out that their graduates require a good understanding of professional and workplace issues as well as technical skills.

The need for teaching professional skills to undergraduates in areas such as information systems, IS, is analyzed in [16]. The authors establish the following objectives for the components of training in professional skills: i) to introduce students to a range of professional skills considered essential for their effective operation as IS professionals, ii) to develop skills and attitudes in students appropriate to IS professionals, and iii) to ensure that the acquisition of these professional skills are regarded at all times by students as relevant to the technical and theoretical programs they are receiving concurrently. In [17] the authors focus on the need not only of acquiring but also of applying these skills throughout the course and beyond. The need to develop professional values is recognized in Computing Curricula 2001 (CC2001), drawn up by the IEEE and ACM [18]. CC2001 discusses how professional practice can be assessed. For instance, the assessment process should i) encourage students to employ good technical practice and high standards of integrity, and ii) discourage students from attempting to complete work without giving themselves enough time or in a haphazard manner.

[19] describes a survey of the attitudes of students, faculty and professionals in computing towards the teaching content and assessment. The results show that these groups share a set of professional values, although students are less convinced of their importance in the work environment. A broad consensus exists to the effect that explicit teaching and assessment of professional values and behaviors may encourage convergence between the academic and employment goals and environments, as well as creating better career prospects for more graduates. In [20], from another point of view, the authors address the pros and cons of using Computer Aided Assessment (CAA) for tackling the assessment task.

III. THE EVALUATION GUIDE FOR FYPS

As described in [1, 2], the "Guidelines to the evaluation of competences in the Bachelor and Master Degree thesis in engineering" establish a design procedure in six stages for assessing the FYP of the degree (see Fig. 1):

1) *Definition of the skills associated with the FYP and selection of the objective indicators for each skill*

2) *Definition of milestones for evaluation, the concrete actions of assessment to be adopted at each milestone and the agents who will carry out such actions. Three possible milestones are defined:*

- Initial milestone, with two actions of evaluation: a written report and an oral presentation.
- Follow-up milestone, with a single action of evaluation based on a progress report.
- Final milestone, with two actions of evaluation: the report of the project and its public presentation.

3) *Assignment of indicators to each action of the assessment.*

4) *Definition of a rubric for each indicator, establishing a clear and objective criteria for the evaluation of the indicator.*

5) *Definition of the reports that evaluator agents must complete.*

6) *Definition of the criteria for assigning the final grade to the FYP based on the evaluation reports.*

To set the guide for the Barcelona School of Informatics (FIB) FYP evaluation, a multidisciplinary commission formed by the first nine authors of this work was appointed. The members of the commission met regularly between February and July 2011 to discuss the various stages of the Guide definition process and to make decisions on all aspects not covered by the guide. From July 2011 to July 2012, the FIB continued work on the implementation of the commission's recommendations. The decisions taken on the basis of the FIB rules for the evaluation of the FYP are detailed in the following sections.

IV. REFERENCE FRAME

The FIB curriculum includes five disciplines of the Royal Decree 1393 / 2007 [21]: Computing, Computer Engineering; Software Engineering; Information Systems and Information Technology. The students are evaluated on nine professional skills:

- Entrepreneurial attitude and innovation.
- Sustainability and social commitment
- Foreign language.
- Effective oral and written communication.
- Teamwork.
- Proper use of information resources.

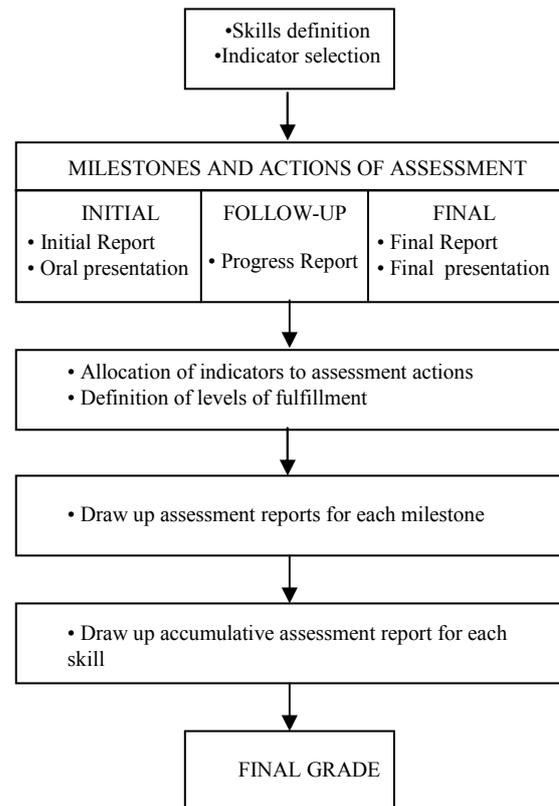


Figure 1. Proposed procedure on the guide to define the FYP evaluation process.

- Autonomous learning.
- Appropriate attitude to work.
- Reasoning.

We decided that all the skills should be evaluated in the FYP, with the exception of foreign language and teamwork (FYP are individual assignments in the FIB, with some exceptions). Foreign language skills are evaluated optionally and at the request of the student, since at the Universitat Politècnica de Catalunya - BarcelonaTech (UPC) students must prove during their degree studies that they possess competence in a foreign language (level B2.2 or higher in the case of English). If they have not accredited it, they may do so by writing and presenting the FYP in English. In any case, the grade for "foreign language" skills does not affect the final grade of the FYP.

The FIB curriculum defines a FYP of 18 ECTS credits. Students can do the FYP in a foreign university through a mobility program. Most of the European universities establish a FYP of 15 credits (as well as some American and Asian universities with whom we have cooperation agreements), so the 18 credits have been divided into two blocks to achieve compatibility with our FYP with a mobility agreement:

- A block of 15 credits for the development of a project, similar in the number of credits to many foreign universities.
- A block of 3 credits in which the student is instructed in project management. We refer to this block as PM (project

management); it is organized as a blended learning course and is detailed in Section IV.

These two blocs have a joint single grade corresponding to the 18 credits. Many foreign universities have subjects similar to PM, so it is simple to set up validations.

V. PM: PROJECT MANAGEMENT

PM is organized as a semi-intensive three-week seminar. It is offered twice a year, in February and July, and coincides with the end of semester of regular classes. There are several reasons for this distribution:

- Taking PM at the end of a semester enables students to do their FYP in the following semester, so students receive training in project management before starting their FYP. This allows students to study the FYP in the eighth semester of their degree course, and therefore to finish their graduate studies in the four years envisaged (the bachelor Degree in Spain is four semesters long).

- A FYP credit is equivalent to 30 hours of student work in our University. 3 PM Credits therefore correspond to 90 hours, or 30 hours per week, which we consider a reasonable ratio for an intensive seminar.

- It provides access to the subject for those students who are on an exchange program and do not have a subject such as PM available at the center where they are doing their FYP. It is likewise made available for those students who are doing the FYP in a national or foreign company.

PM objectives are arranged in four modules, three common to all students and one specific to the specialty in which the student is enrolled (the FYP is part of the specialty). This module addresses the specific aspects of the management of projects in the field. The four modules are on-line.

As the students progress through PM, they are required to present several reports in which the knowledge acquired is applied to their FYP. We consider that 50% of the time should be devoted to studying the four PM modules, and the other 50% to applying what has been learned to the writing of the FYP. Near to the middle of the course, the documentation generated by each student is presented very briefly (three minutes) in a whole-body video, which is then sent to the professor who in turn provides quick feedback. At the end of the three weeks of the course, a 5-minute public presentation is conducted in face-to-face format (or by videoconference or a similar system for students who are abroad). Each student presents the work done and receives direct feedback from the teacher. The PM Professor and the project director carry out the evaluation of this presentation and the reports prepared during the course, the result of which is the evaluation of the initial milestone. Next, we describe briefly the four PM modules and topics for which students must present documentation showing that they are applying the PM learning to their FYP:

- Module 1: Information Technology Tools (ITT) to support the management of projects and teams. The following

topics are covered in this module: (1) specific applications of project management, (2) Internet resources for management and (3) management of the FYP through the network.

- Module 2: Basics of project management. The following topics are covered in this module: (1) integral project management, (2) scope management - deliverable 1: scope-definition, (3) time management - deliverable 2: planning calendar, (4) economic management - deliverable 3: budget, (5) other areas of management.

- Module 3: Personal and professional skills for the management of projects and teams. The following topics are covered in this module: (1) management of people and equipment - deliverable 4: preliminary presentation, (2) information skills - deliverable 5: context and literature, (3) efficient communication techniques.

- The contents of the 4th module depend on the specialty. The different characteristics of projects of each specialty are detailed in this module.

One week after the end of the four modules, the student must submit a document summarizing all deliverables achieved so far (introduction and State of the art, scope of the project, temporary planning, budget, and bibliographical references consulted), adapted according to the criteria described in module 4. This compilation and the public presentation is what will be evaluated at the initial milestone.

The procedure to evaluate the FYP is detailed on Section VI.

VI. EVALUATION MILESTONES/INDICATORS

We have decided to evaluate the FYP through three milestones and three actions of evaluation. Both the initial and the final milestone, the evaluation of the delivered documentation and the public presentation are included in a single evaluation action. Each milestone has his own agent evaluator, and evaluation is done according to a set of indicators whose valuation is defined accurately by means of a rubric.

A software application has been designed to facilitate the processes of evaluation. In this software, the different evaluator agents can quickly and easily introduce their qualifications by selecting their assessment on the rubric of each indicator. We use a four-level compliance for competence evaluation for each indicator: Not reached; almost reached; reached as expected and reached with excellence. From the information obtained in the three acts of evaluation, the software application automatically calculates the final FYP grade.

A. Initial milestone

The initial milestone occurs during the first month of work on the FYP, while students are studying the PM. The initial milestone evaluates the reports submitted by PM students and a public presentation to colleagues on the course. The presentation is delivered within the framework of the PM

course. The report is evaluated both by the PM Professor and by the FYP director, who also acts as the evaluator agent.

The rubric of the initial milestone has eight indicators, four to assess the public presentation and four to evaluate the documentation submitted. The indicators are described below:

- 1) *Formulation of the problem to be solved,*
- 2) *Initial planning of the work to be done, describing how the monitoring of such planning will be conducted, and an initial budget,*
- 3) *Description of the methodology to be used, monitoring tools and methods for results validation,*
- 4) *An initial analysis of the possible impact of the project in social, environmental and economic terms (sustainability analysis),*
- 5) *Clear and correct written expression,*
- 6) *Oral communication: verbal language,*
- 7) *Oral communication: body language, and*
- 8) *Oral communication: correct use of support elements.*

The public presentation is face-to-face for students enrolled in the FIB, but can be done through a videoconference system (e.g. via Skype or similar systems) for students who unable to attend. Students who working on the project in a company may choose to make the presentation in person or by telematics.

The oral presentation of the report is given in small groups of 8-10 students. Each student has 5 minutes to make his or her presentation and 5 minutes to answer questions from the professor or course colleagues. The teacher provides feedback.

Should they consider it appropriate, in their assessment the project director or PM teacher may include comments on any deficiencies in the definition of objectives or planning, for example, and ask for proposals for correction.

At the end of the initial milestone, the student proposes and plans when the action of assessment regarding the follow-up milestone should occur, more or less when 50% of the FYP has been completed. Since the duration of a FYP is estimated to last between 4 to 6 months, the follow-up milestone should occur within two or three months after the initial milestone assessment.

B. Follow-up milestone

The Follow-up milestone is evaluated from a student's report and an (optional) interview with the director. The FYP director acts as agent evaluator. The Follow-up milestone rubric has eight indicators, two of which have previously been evaluated in the Initial milestone (Planning and Methodology, although not using the same rubric):

- 1) *Contextualization of the project, description of the background and analysis of possible solutions and technologies,*
- 2) *Monitoring of planning, justifying any deviation,*

3) *If any changes have been made to the proposed methodology, the justification for such changes and the description of the new methodology,*

- 4) *Justification of the selected option,*
- 5) *Student's ability to take initiatives and decisions, weighing the risks and opportunities,*
- 6) *Student's ability to engage in work, showing a professional attitude and behavior,*
- 7) *Integration of knowledge and generation of creative solutions, and*
- 8) *Identification of regulations (laws, rules, etc...) potentially affecting the project.*

The director may suggest changes to the student if he considers that something lacks sufficient accuracy. If he considers that the project deviates substantially from the original schedule, he may propose a new assessment date for the Follow-up milestone. The new evaluation date may be set in agreement with the student. Should the Follow-up assessment be repeated several times, only the last one is evaluated. The evaluation may reward students who have done a satisfactory job (even though not in accordance with the initial planning), but may can penalize those who have had to make several unjustified evaluations of the Follow-up milestone.

C. The Final milestone

In the Final milestone, the final report and the public presentation of the FYP are evaluated. Both actions are evaluated by a committee, as is customary in most schools with the previous FYPs. The final milestone must take place no later than one year after the student enrolled in the project. Otherwise, the student must re-enroll for the project (UPC rules).

The Final milestone rubric consists of ten indicators:

- 1) *Resolution of the initially formulated problem and scope of the proposed objectives,*
- 2) *Monitoring of planning, justifying the adjustments made, and an analysis of the project cost,*
- 3) *The existence of enough information to reproduce the process of analysis, synthesis and evaluation. When the evaluation is numerical, a correct and reasoned presentation of numbers,*
- 4) *Analysis of the impact of the project in social, environmental and economic terms (sustainability analysis)*
- 5) *Structure and organization of work,*
- 6) *Clear and correct written expression,*
- 7) *The use of information resources,*
- 8) *Oral communication: verbal language,*
- 9) *Oral communication: body language, and*
- 10) *Oral communication: correct use of support elements.*

All milestones rubrics as well as all the information regarding the FYP assessment are accessible on the FIB web site.¹

We have not defined any format for the FYP report due to the fact that there are many particular report formats, and defining a concrete format, even just a different one for each specialty, would limit students' creativity and would probably fail to fit all projects. However, it is mandatory that all reports begin with an abstract consisting of one or two pages and written in Spanish, Catalan and English.

Given that the Royal Decree 1393/2007 [21] specifies that the FYP must be associated to one of the five specialties of the Computer Engineering Degree, it seems appropriate that each FYP be evaluated by a specific committee in that specialty.

If desired, the committee may consult the evaluation reports of the Initial and Follow-up milestones. The Committee consists of three professors: one chairperson and two members. At least two committee members should be able to assess the technical skills of the project. The director of a FYP cannot be a member of the committee that assesses that FYP. Therefore, a deputy member is appointed in each committee to meet contingencies or to act as a substitute should one of the members be the director of one of the projects evaluated.

Two assessment periods are defined each semester, one at mid-semester and another at the end (four periods per year). Each evaluation period may last one or two days. The FYPs are grouped into blocks of up to three projects, which are evaluated by the same committee during a morning or an afternoon. Students have 30 minutes to deliver their presentations, and the committee has 15 minutes in which to pose questions or request clarifications. In case where more than three projects must be evaluated, they are grouped into a new block and are evaluated by a different committee. This structure makes it easier for directors to avoid evaluating projects they may have supervised, prevents overload for teachers who are committee members (whose work is limited to a morning or an afternoon, plus the time spent reading the reports), and ensures that at least two of the board members are able to make a technical assessment of the project.

In order to make it easier for teachers to familiarize themselves with the new evaluation system, their first role in a committee will never be as a chairperson. Thus, the chairperson must have previously served on a committee. This process will always ensure that at least one member of the committee has had prior experience of the evaluation process.

D. Process for indicator selection

For the definition of indicators, we use as a starting point the indicators identified by the "Guidelines to the evaluation of competences in the Bachelor and Master Degree thesis in engineering" This guide focuses on the 30 professional skills

defined by the Tuning project², and defines specific indicators for assessing the FYP (and Final Master Project) for each one.

As described in Section 3, the FIB has selected nine professional skills to address and evaluate within the Computer Engineering Degree. While some of these skills can be clearly identified as any of the Tuning skills (for example, teamwork or oral and written communication), most of them include several Tuning skills, or at least several aspects of different skills. For this reason, the method we use to select the indicators for each milestone assessment is as follows:

- 1) *Review the FYP evaluation indicators for all Tuning skills.*
- 2) *Select the relevant indicators to assess the FIB professional skills.*
- 3) *Gather indicators that are similar or can be evaluated jointly.*
- 4) *Add indicators (that may be deemed appropriate) not found in the guide.*
- 5) *Redistribute the indicators among milestones according to the distribution given in the guide, as shown in Table 1. Some indicators may appear in more than one milestone, and their description is simplified for greater clarity.*
- 6) *Check each milestone to prevent an excessive number of indicators.*
- 7) *Assign the indicators to their respective FIB skills, as shown in Table 2.*
- 8) *Make the rubric for each indicator. The rubric may be different for the same indicator appearing in more than one milestone.*

The purpose of this process is to arrive at a limited number of indicators enabling the professional skills of the FYP to be assessed.

A group of professors from the FIB, including some of the authors of this work, have carried out a general review and have rewritten an earlier version of the indicators in order to give coherence to the whole, as well as defining the content of the rubrics. The point of departure was the list of indicators present in the guide. The final result of all this work is presented in this paper.

VII. FINAL ASSESSMENT

The process described so far is applied to the assessment of the professional skills. Given the enormous casuistry of FYPs, we believe that this process cannot be applied to specific skills of a degree or specialty. In fact, the "Guidelines to the evaluation of competences in the Bachelor and Master Degree thesis in engineering" focuses on the assessment of professional skills, while the assessment of specific competencies is left to the school criteria.

¹ <http://www.fib.upc.edu/es/estudiar-enginyeria-informatica/treballfinal-grau.html>

² <http://www.unideusto.org/tuning/>

Table 1. Distribution of the milestone indicators.

| Indicator | Initial milestone | Intermediate milestone | Final milestone |
|--|-------------------|------------------------|-----------------|
| Problem statement | X | | X |
| Contextualization | | X | |
| Planning | X | X | X |
| Methodology and Rigour | X | X | X |
| Considering different alternatives | | X | |
| Sustainability | X | | X |
| Initiative and decision making | | X | |
| Attitude and professional behaviour | | X | |
| Integrating knowledge and creative problem solving | | X | |
| Identification of regulatory elements and norms | | X | |
| Organization and structuration of work | | | X |
| Apropriated knowledge of written skills | X | | X |
| Use of information resources | | | X |
| Oral communication: verbal language | X | | X |
| Oral communication: body language | X | | X |
| Oral communication: use of supporting elements | X | | X |
| Prepare reports in English | | | X |
| Conduct presentation in English | | | X |

The criterion adopted by the FIB has been to evaluate specific skills altogether during the final milestone. In other words, by using the appropriate criteria for each project (they may be different for each project), the committee members who are competent to evaluate the project technically decide what corresponding qualifications to award to the specific skills of the FYP. Given such a high FYP casuistry, we believe that the assessment of the technical part of the project should be subject to the expertise of the committee members. We are aware that this may lead to a repetition of the same errors found in the evaluation of the previous FYP, but we have yet to find a better way to do it. Moreover, we are of the opinion that the simultaneous evaluation of several FYPs by the same committee will provide a fairer assessment.

As regards the percentage of the final grade, we consider that specific skills should constitute 60% of the grade and professional skills the remaining 40%. One way to justify this distribution would be the answer to the question: "What grade would you give to an excellent project with a horrible report and a forgettable oral presentation?" Using our weight distribution, that project would receive 6 out of 10.

We have determined that all indicators should be weighted equally within each milestone and have defined the following weights for each milestone: 25% for the Initial milestone, 25% for the Follow-up milestone and 50% for the Final milestone. Since this percentage corresponds to the assessment of professional skills, which accounts for 40% of the total grade of the FYP, the result is that the Initial milestone constitutes 10% of the final grade, the Follow-up Milestone another 10%, and the Final Milestone 80%: 20% to assess professional skills and the remaining 60% to assess specific skills.

Table 2. Distribution of indicators according to professional skills.

| Indicators/ skills | Entrepreneurship and Innovation | Sustainability and social | Oral and written communication | Appropriate use of information technology resources | Autonomous learning | Appropriated attitude to work | Foreign language | Reasoning |
|--|---------------------------------|---------------------------|--------------------------------|---|---------------------|-------------------------------|------------------|-----------|
| Problem statement | | | | | | | | X |
| Contextualization | | | | X | X | | | |
| Planning | X | | | | | X | | |
| Methodology and Rigor | | | | | | | | X |
| Considering different alternatives | X | | | | X | | | X |
| Sustainability | X | X | | | | | | |
| Initiative and decision making | X | | | | X | X | | |
| Attitude and professional behavior | | | | | | X | | |
| Integrating knowledge and creative problem solving | X | | | | X | X | | X |
| Identification of regulatory elements and norms | | X | | X | X | | | |
| Organization and structuration of work | | | X | | | | | |
| Apropriated knowledge of written skills | | | X | | | | X | X |
| Use of information resources | | | X | X | | | | |
| Oral communication: verbal language | | | X | | | X | X | |
| Oral communication: body language | | | X | | | X | | |
| Oral communication: use of supporting elements | | | X | X | | | | |
| Prepare reports in English | | | | | | | | X |
| Conduct presentation in English | | | | | | | | X |
| TOTAL | 5 | 2 | 6 | 4 | 5 | 6 | 4 | 5 |

Due to the fact that some indicators are evaluated in more than one milestone, as shown in Table 1, we believe that it is appropriate to disregard the three worst indicators for the final qualification when some improvement in the project progress has been detected. This enables any corrections made by students of deficiencies identified during the implementation of the FYP to be taken into account.

Finally, the committee's report on the Final milestone contains an option to indicate whether the FYP deserves an added value, either for the quality of the work, the applicability of the results, or for any other reason that the committee might consider. The reasons for this must be justified and in no circumstances may match any of the indicators that have already been evaluated. These FYP may be awarded up to an extra point for the final grade.

The aim of these measures is to detect those exceptionally good FYPs with an outstanding evaluation when compared with others, even meriting the award of honors. Projects graded with a final score greater than 9.5 may be awarded according to the criteria of the committee. All these measures are deemed necessary, since when an assessment is obtained from the sum of so many evaluative acts (as in the case of FYP, given the large number of indicators involved), the final grade is usually subject to a normal distribution far removed from the highest grades, which are very difficult to obtain.

The whole process described in this section is easily performed with the use of the software application commented at the beginning of Section 5. The committee's work during the final milestone is reduced to selecting the assessment of every indicator from its rubrics by a single click, and deciding whether or not it is an FYP of exceptional quality. Should any disagreement arise among the members of the committee, the

decision is taken by majority vote. For FYPs conducted in companies, the described evaluation system is also used. For FYPs undertaken in foreign universities, the grade obtained at the center where the project was conducted is deemed acceptable.

Finally, a grade for each professional skill is extracted from the indicators evaluated in the three milestones (see Table 2). This grade complements the grades obtained at that point by the student, should the school assess the professional skills independently (as in our case).

VIII. STUDENT GUIDE

Rubrics are very useful as a guide for evaluator agents and for unifying criteria. In the case of FYP evaluation, where different evaluator agents with different backgrounds act, it is very important to have precise rubrics that enable students to be assessed by eliminating the degree of subjectivity present in any evaluation as far as possible.

However, precise rubrics have a drawback: they contain too much information to provide useful guidance for the student.

Therefore, in order to guide the student, we have developed a proposal based on the Socratic Method [22]. This guidance is based on a set of questions that students should consider while carrying out their FYP. The answers to some of these questions should be reflected in the final FYP report, while other questions should help students to address issues that facilitate progress in the right direction.

IX. CONCLUSIONS

The EHEA represents an excellent opportunity to reconsider the evaluation procedure of the Final Year Projects (FYP) and to improve the way this has been conducted so far. Traditionally, the assessment has been carried out according to vague criteria based on previous experience of the evaluator agents.

We need to rethink the way in which the FYP is evaluated in order to ensure traceability of the assessment and transparency of the assessment criteria.

In this paper, we present a proposal for the evaluation of FYP based on the recommendations of "Guidelines to the evaluation of competences in the Bachelor and Master Degree thesis in engineering". The assessment is based on three evaluation milestones: the Initial milestone, the Follow-up milestone, and the Final milestone.

The assessment in each milestone is based on a set of indicators. The evaluation criteria for each indicator are defined by a precise rubric that is known to students prior to undertaking their FYP.

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