

# Assessing an Appropriate Attitude towards Work in Engineering Education\*

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Appropriate attitude towards work is a generic competency developed in the Bachelor's Degree in Computing Engineering at the Barcelona School of Informatics. This competency includes: the ability to work in teams with responsibility and respect, a proactive attitude, motivation for quality and the continuous improvement in processes and results, as well as the adaptability to organizational and technological changes. In order to develop this competency into a comprehensive integrated experience, a definition in terms of dimensions, which are further defined according to three-level objectives, is required. A set of activities to achieve each objective is proposed. The goal is to define this set in a way that makes it easily integrated into the contents of each course where the competency is involved. The evaluation of the competency can be obtained tracking the progress of students developing these activities. This paper presents a proposal to develop and assess this competency, with a six semester experience integrating activities in the degree program.

**Keywords:** engineering education; generic competencies; interpersonal skills

## 1. Introduction

In recent years, European universities, including the Universitat Politècnica de Catalunya-Barcelona-Tech (UPC), have adapted their academic programs to the European Higher Education Area (EHEA). At the UPC, the adaptation to the EHEA was done by following the framework provided by the Tuning project [1]. This project identifies reference points for technical and generic competencies in different areas. Competencies represent a dynamic combination of knowledge, understanding, skills and abilities. Technical competencies guarantee the acquisition of knowledge in each area, and generic competencies enforce transversal skills and practices that are appropriate for most areas and can be applied to a variety of jobs, situations or tasks [2].

All these circumstances drove the Barcelona School of Informatics (FIB) to assign some of the generic competencies listed in the Tuning project to courses of its Bachelor's Degree in Computing Engineering (BDCE) [3]. One of these generic competencies, appropriate attitude towards work, will be deeply analyzed in this paper.

The attitude can be defined as the tendency to act in a certain way towards persons and situations [4]. Additionally, attitudes are commonly viewed as summary evaluations of objects (e.g. oneself, other people, issues, etc) along a dimension ranging from positive to negative [5]. Among social and behavioral psychologists, attitude is also known as a good predictor of behavior [6]; thus, attitude can be described as a set of parameters dictating an individual's behavior patterns [7]. To recognize an appro-

priate attitude towards work, or an understanding of professional and ethical responsibility [8], the parameters that are valued in the professional environment must be identified. An important part of those is personal relationships skills [9].

The idea of implementing this competency is to identify the academic parameters needed to strengthen the professional skills. During their academic life, the student should improve the following skills: the ability to work in teams with responsibility and respect, a proactive attitude towards work, motivation for quality and continuous improvement, motivation for professional achievement and to address new challenges, the ability to adapt to organizational and technological changes, the capacity to work in situations with lack of information and time and resource constraints, the capacity for personal integration in an industrial environment, a wide view of the possibilities of the long term professional career and the realization of rigorous professional development.

From all these skills, a set of dimensions (aspects of the competency) is identified, which can be defined according to three-level objectives (based on Bloom's taxonomy [10]) as Table 1 shows.

The paper is structured as follows. In section 2, the map of the competency is presented detailing its objectives and activities for the three-level dimensions. Section 3 describes the methodology applied to the courses that have this competency assigned and an example of the activities developed and assessed in one course. The discussion of the results of six semesters experience is reported in section 4. Finally, section 5 includes some conclusions and ideas for future work.

**Table 1.** Map of the competency

Dimension	Level 1 Knowledge	Level 2 Comprehension	Level 3 Application
Efficient management of working time	2.1.1	2.1.2	2.1.3
Respect	2.2.1	2.2.2	2.2.3
Rigor in achieving the technical competencies of the course	2.3.1	2.3.2	2.3.3
Motivation	2.4.1	2.4.2	2.4.3
Ability to identify shortcomings and aspects to improve	2.5.1	2.5.2	2.5.3
Responsibility in learning	2.6.1	2.6.2	2.6.3
Active interest in obtaining quality results	2.7.1	2.7.2	2.7.3
Capacity to adapt to organizational and technological changes	2.8.1	2.8.2	2.8.3
Professional realization	2.9.1	2.9.2	2.9.3

## 2. The methodology: objectives and activities for each dimension and level of the competence map

In Table 1 the map of the competence has been presented. In this section the description of the objectives for each level and dimension are explained in detail, as well as the activities to develop in each of them.

One of the main goals of the EHEA is to promote competence-based learning which fosters a change in teaching methodologies, from a lecture-centered approach to a more learner-centered one [11]. Following these guidelines, a set of activities to achieve the generic competence has been defined for each level and dimension. The activities have been selected from the related literature on learner-centered approaches [8, 11–29]. For each activity, a file was created including: the name of the activity, description, objectives, the name of the assessed competence, other involved competencies, tasks of the teacher to prepare the activity, tasks of the students during the class and at home, teacher schedule, students schedule during the class and at home, documentation for the teacher, documentation for the students, environmental conditions necessary to carry out the activity by the centre, the teacher and the students, indicators to show that the students have achieved the objectives of the activity, what type of evaluation is the most appropriate

for each indicator (self, peer review, formative, summative, other), evaluation tools (exams, rubrics, tests, other), subjects that are appropriate for the activity, and additional comments. However, given the purpose of the paper and the size and level of detail of the activity files, only a brief description of each activity is presented here. Due to some activities develop a set of skills; the same activity can be used at different levels and dimensions. For example, the *Teamwork with Cooperative Learning Techniques* activity in the *Databases (BD)* course promotes: capacity to plan and manage time, active interest in obtaining a quality solution, capacity for learning from team-mates, capacity for teamwork enforcing positive interdependence regarding team-mates, capacity to discern among possible solutions and capacity to adapt and manage changes of role in the team [30].

### 2.1 Efficient management of working time

Forming an appropriate attitude includes the ability to handle and manage working time; From the most basic things such as the habit of being punctual, to the more complex such as long-term planning of work. The objectives at the three levels are shown in Table 2.

#### 2.1.1 Level 1

For this level, the activities selected focus on the most basic concepts of the management of time such

**Table 2.** Objectives for efficient management of working time

Level 1	Level 2	Level 3
Understand and be aware of the importance of organizing time efficiently and actions that entails: develop a schedule of the academic year, identify overlaps between subjects and/or other activities and take appropriate actions to ensure attendance and punctuality.	Given an activity to be performed, define and rank work based on priority.	Given an activity to be performed, set goals and priorities and short, medium and long term planning.

as attendance and punctuality, following the active learning principles [11]. The activities are:

- Short question at the beginning of the class. The activity consists of answering a question at the beginning of the class about the contents of the previous class.
- Educational planning course. The activity consists of developing a schedule of tasks for a semester in a course.

### 2.1.2 Level 2

Working in groups with the well-known cooperative or collaborative techniques [12-14], the student must be conscious of the importance of the management of time. The selected activities are:

- Teamwork with cooperative learning techniques.
- Collaborative work in teams.

Both activities are required to be solved with time constraints and the students should schedule the steps of the activity to finish on time.

### 2.1.3 Level 3

To apply the knowledge acquired in the previous levels, students should be able to perform more complex planning. The selected activities are:

- Short, medium and long term (strategic) planning [15].

## 2.2 Respect

In a professional environment, no one works alone and when working with other people is very important to learn how to respect other team-mates. The objectives at the three levels are shown in Table 3.

### 2.2.1 Level 1

The best way to understand the concept of respect is to establish relationships with team-mates. The selected activities are:

- Teamwork with cooperative learning techniques.
- Teamwork playing different roles [16].

During these activities, the teacher observes the attitude of team-mates and if any problem concerning respect is detected, some actions are taken depending on the level of intensity of the problem, with the goal of creating awareness on the team and letting them conduct the activity better.

### 2.2.2 Level 2

The activities selected at this level are appropriate to the student becoming aware of their level of respect to others. Communicative activities [8] are very helpful in this sense, as are debates and interviews:

- Debates.
- Interviews.

In these activities, the role of the teacher is to moderate the students for them to act with respect.

### 2.2.3 Level 3

At level 3, it is time to practice again with team-mates and consolidate the acquired respect knowledge. The selected activities are:

- Teamwork with cooperative learning techniques.
- Collaborative work in teams.
- Teamwork playing different roles.

During these activities, the teacher observes the attitude of team-mates and confirms that students act in a respectful way.

## 2.3 Rigor in achieving the technical competencies of the course

Another aspect of an appropriate attitude is how the student obtains technical knowledge. With the acquisition of rigor, students indirectly increase their acquisition of technical knowledge. The objectives at the three levels are shown in Table 4.

**Table 3.** Objectives for respect

Level 1	Level 2	Level 3
Understand the skills that characterize a respectful person: to not disturb in class, maturity, ethical responsibility, accept that there is more than one way of thinking of a situation or a problem, etc.	Given an example activity, evaluate their own actions or those of others and decide whether they meet the criteria of respect. In the event of failure to meet them develop personal resources to overcome their own limitations.	Given an activity, act on the skills that characterize a respectful person.

**Table 4.** Objectives for rigor in achieving the technical competencies of a course

Level 1	Level 2	Level 3
Understand the concepts of precision, detail and correction as a principle in the development of the technical skills of the subject.	Given an example activity, identify actions that characterize the rigor.	Apply the necessary actions to develop the technical skills of the subject with precision, detail and correctness.

### 2.3.1 Level 1

A good exercise to understand precision, detail and correctness is to prepare a summary of the course.

- Preparation of a report of the course. This activity is a good exercise to learn how to develop a quality report. Previously, the teacher should explain how to do this, following learning instructional objectives [11].

### 2.3.2 Level 2

At this level, a guided activity has proposed to students achieve interest in quality results:

- Pass all the computer tests proposed in laboratory classes. The teacher creates a set of computer based tests from the contents of laboratory classes. The students must pass all tests. Each test not passed gives a clue as to where the problem is. The students correct the error and try again. The idea of this activity is that the students learn how working with rigor can enable them to pass all the tests. In [17–18], examples of this type of activity can be found.

### 2.3.3 Level 3

The activities involving more initiative are proposed at this level, for the students to apply previously learned rigor:

- Suggestions for additional work. The student proposes to the teacher an additional work related to technical competencies of the course and applies the principles of precision, detail and correctness in the preparation of the work.
- Preparation of exam questions. The students participate in learning and performance assessment. They create potential rigorous examination questions, and some of them have been used in the exam [19].

## 2.4 Motivation

Motivation is one of the most valued skills in the professional environment. Motivated people are better professionals and a good example for their team-mates. The objectives at the three levels are shown in Table 5.

### 2.4.1 Level 1

Teamwork activities are a very good way to understand the importance of active participation:

- Teamwork with cooperative learning techniques.
- Teamwork playing different roles.

During the activities, the teacher encourages students to be more participative.

### 2.4.2 Level 2

At this level, the proposed activities are oriented towards consciousness of the own grade of motivation and how to increase it:

- Oral presentations. Students may observe the presentation of other teams including the teacher's feedback, which highlights strengths and weaknesses of the work. The students are encouraged to articulate general lessons learned which will be applicable to similar work in the future [20].
- Group meetings and check marks. All the students of the class are organized in groups. During a course semester, after a group meeting, the team should submit exercises on which there is consensus. Every time an exercise is presented a check mark appears in a table visible to all groups. As motivation refers to the choices people make as to what experiences or goals they will encounter or avoid, and the degree of effort they will exert in that respect [21], the visible marks motivates other teams to submit their exercises.

### 2.4.3 Level 3

The students who accept responsibility for their own learning successes and failures, increase their own self-perception of competency, and so enhance their motivation [22]. The motivated students are now able to:

- Suggestions for additional work.
- Preparation of exam questions.

These same activities evaluate the rigor dimension, but checking the way they are performed also offers valuable feedback on their level of motivation.

### 2.5 Ability to identify shortcomings and aspects to improve

Another important dimension to achieve an appro-

**Table 5.** Objectives for motivation

Level 1	Level 2	Level 3
Understand concepts of motivation: to be participative, positive, interested in learning, enjoying and self-esteem.	Given an example activity, evaluate their own motivation. Develop personal resources to overcome limitations.	Besides the compulsory activities of the subjects, be receptive to additional activities and even suggest new activities. Realistically assess their own potential and set achievable goals.

**Table 6.** Objectives for the ability to identify shortcomings and aspects to improve

Level 1	Level 2	Level 3
Understand the concepts of personal improvement: to be constant, interested in receiving advice and ideas, learn to recognize the limitations and weaknesses in their processes and methods of work and being aware of the deficiencies in training and when help is needed.	Given an activity such as analyzing a particular situation, self-assessment, evaluation of the work of others and identify action of issues and needs for improvement.	Given a participative activity, make improvements in complex situations and contexts.

appropriate attitude is the ability to identify shortcomings and aspects to improve. In this skill, it is significant not only the need to identify deficiencies, but also the ability to make improvements. The objectives at the three levels are shown in Table 6.

### 2.5.1 Level 1

Teamwork activities are a very good way to understand shortcomings and aspects to improve:

- Teamwork with cooperative learning techniques.
- Teamwork playing different roles.

During these activities, the teacher indicates to students their weaknesses and helps them to improve.

### 2.5.2 Level 2

In order to identify shortcomings and aspects to improve, the best activities are those that imply the assessment of team-mates or personal reflection:

- Peer review [23]. The activity consists of an evaluation of the team-mate only accessible to the teacher.
- Group review [19]. The activity consists of an evaluation of the team-mates only accessible to the teacher.
- Self-reflection blog [24]. The idea of the activity is that a student writes their shortcomings and how he/she considers they can be improved. The blog can be public with suggestions of other students of the course, or private and only accessible to the teacher.

### 2.5.3 Level 3

At level 3, the activities are oriented to make improvements:

- Suggestions for additional work.
- Preparation of exam questions.

The students will apply the skills learned in previous levels to additional work and exam questions in complex situations and contexts.

## 2.6 Responsibility in learning

One of the main business needs is to have responsible professionals. In the academic world, responsibility is going to be measured in terms of how learning is achieved. Individual learners can become empowered to take increasingly more responsibility for various decisions associated with the learning endeavor [25]. The objectives at the three levels are shown in Table 7.

In [25], some key steps are proposed to design activities for this dimension. Along the same lines, the Institute of Education Sciences (ICE) of the UPC defines three levels of autonomous learning (called directed, guided and autonomous) with a description of the type of activities appropriate for each level [26], which can be directly associated with the activities for the three levels used in this work.

### 2.6.1 Level 1

At this level, the activities are extremely directed (complete set of tasks within established deadlines and work with recommended information sources):

- Summaries, reports or questionnaires of autonomous learning. This activity combines Web-based technology with active learning methods in the classroom. The students complete Web-based assignments in which they answer questions, and the teacher reads through their answers and comment the contents in class [27].
- Autonomous learning work for theory, exercise or laboratory classes. The students performs autonomous learning at home in preparation for the class. The advantage of this procedure is

**Table 7.** Objectives for responsibility in learning

Level 1	Level 2	Level 3
Understand the concepts of personal responsibility to always make autonomous learning in a lawful manner, with quality and within the established deadlines.	Given an example activity, identify actions that characterize responsibility and take action for improvement.	Given a participative activity, assess learning and work.

that most students will achieve a deeper understanding of how to solve all the test problems [19].

### 2.6.2 Level 2

At this level, the activities are the same as in the previous level, but now are guided (dedicate the time needed to complete each task, including personal contributions and expanding information sources recommended):

- Summaries, reports or questionnaires of autonomous learning.
- Autonomous learning work for theory, exercise or laboratory classes.

### 2.6.3 Level 3

At this level, the activities include autonomous tasks and teamwork enforcing the ability to be responsible:

- Teamwork with cooperative learning techniques.
- Collaborative work in teams.
- Teamwork playing different roles.

With the teamwork activities, the students apply the knowledge gained in completing a task according to its relevance and importance and decide how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

## 2.7 Active interest in obtaining quality results

Technical competencies require that results have high quality. The generic competency develops active interest to do so. The objectives at the three levels are shown in Table 8.

### 2.7.1 Level 1

The activity consists in publishing the rubrics that will be used to assess technical competencies:

- Understanding rubrics.

### 2.7.2 Level 2

At this level, the activities are focused on the

students develop critical reasoning skills to reach the highest level of quality:

- Solved exercises to analyze and evaluate quality. This activity is about diagnosing quality problems in an exercise and formulates solution strategies.
- Solved cases and evaluation guide. This activity consists of analyzing solved cases and elaborating evaluation guides. Evaluation guides are a first step to understand the creation of rubrics.

### 2.7.3 Level 3

The activity consists of using or creating rubrics to assess exercises:

- Use or create rubrics [28].

## 2.8 Capacity to adapt to organizational and technological changes

This dimension develops the ability to adapt to organizational and technological changes, and the capacity to work in situations with lack of information and time and resource constraints. The objectives at the three levels are shown in Table 9.

### 2.8.1 Level 1

A good exercise to understand the organizational and technological changes is to prepare a summary of the course tasks.

- Preparation of a report of the course tasks. This activity evaluates the rigor dimension, but is also a good exercise to learn how to adapt to changes, and time and resource constraints. Previously, the teacher should explain how to do this, following learning instructional objectives [11].

### 2.8.2 Level 2

The best way to adapt to different situations is to play different roles:

- Teamwork playing different roles.

**Table 8.** Objectives for active interest in obtaining quality results

Level 1	Level 2	Level 3
Understand the quality criteria for achieving technical competency in the subject.	Given an example activity, identify deviations from quality standards that have made and learn to apply these criteria to reach the highest level of quality.	Given a participative activity, develop it properly applying the quality criteria.

**Table 9.** Objectives for capacity to adapt to organizational and technological changes

Level 1	Level 2	Level 3
Understand techniques, tools and methodologies applicable to work with changes, and time and resource constraints.	Given an example activity, identify where to apply the techniques, tools and methodologies to organizational changes and time and resource constraints.	Given a participative activity, practice with techniques, tools and methodologies applicable to work with organizational changes, and time and resource constraints.

**Table 10.** Objectives for professional realization

Level 1	Level 2	Level 3
Understand the range of professions where in to apply studies. Develop professional pride.	Given an example activity, detect unprofessional attitudes.	Given a participative activity, put into practice all the knowledge acquired during their studies in a professional manner.

### 2.8.3 Level 3

At this level, the selected activities are:

- Exercises promoting adaptation to changing requirements.
- Exercises with time and resource constraints.

### 2.9 Professional realization

Professional realization can be defined as a wide view of the possibilities of the long-term professional career and the performance of rigorous professional development. The objectives at the three levels are shown in Table 10.

#### 2.9.1 Level 1

The activities for this dimension are:

- Visits to significant industrial environments. The idea is that visiting significant industrial environments, the students become aware of the kinds of real situations they might have to face as professionals.
- Talks by invited professionals. Bringing professionals into the classroom as invited speakers offers the chance to discover new career opportunities and an increase in student's positive attitudes towards the profession [29].

#### 2.9.2 Level 2

The selected activity is:

- Analysis of professional articles and videos. Reviewing selected articles and videos is a good activity to detect unprofessional attitudes and recognize appropriate ones.

#### 2.9.3 Level 3

The selected activities are:

- Suggestions for additional work related to professional accomplishment.
- Interviews. This activity is about interviewing the students and assessing their employment of all the knowledge acquired during their studies in a professional manner.

## 3. Applying the methodology to the courses

The BDCE of the FIB was introduced during September 2010. Their duration is 4 academic years (structured in semesters) with a study load of 240 European Credit Transfer and Accumulation

System (ECTS): 132 compulsory, 48 specialization, 42 optional (elective, specialization, seminar. . .) and 18 for the final project. The FIB is among the few schools in Spain that allows students to take the five specializations on the BDCE: Computing, Computer Engineering, Software Engineering, Information Systems and Information Technologies.

Compulsory courses are made the first two years. Some compulsory courses, such as *Interaction and Interface Design (IDI)*, are expected to be done in the third year. Specializations are chosen at the end of the second year and start during the third year (the first semester with only specialization compulsory courses, and the second semester students can start to combine specialization compulsory with complementary). Students will be awarded a BDCE in the specialization chosen. In the final year of the BDCE, students take optional courses and work on their final project.

Unlike other universities that have implemented the generic competencies through specialized courses, the FIB decided to integrate the development and assessment of the generic competencies into the different courses applying the methodology presented in the previous section. The FIB has nine generic competencies to develop, distributed between all the courses of the BDCE. The courses of the BDCE that have the appropriate attitude toward work competency assigned are showed in Table 11.

Each course has different technical competencies to develop, and thus different academic contents. This is the reason that each one selects different dimensions and objective levels to work with, using the most appropriate activities. Thus, one course may integrate dimensions at different levels, which contributes to an integral educational experience. The different technical contents of these courses can be found at [31]. The distribution of dimensions and levels between this set of courses completely covers the competency map as Table 12 shows and guarantees that a student can cover all aspects of the competency during their academic life in the BDCE.

### 3.1 An assessment example: the BD course

The coordinator of the competency and the coordinator of the course, after analyzing the course contents, decide the dimensions and levels to work. When this is done, it remains only to decide the activities to integrate into the course. Table 13

**Table 11.** Courses that have the appropriate attitude towards work competency assigned

COURSES	Common Compulsory	Computing	Computer Engineering	Software Engineering	Information Systems	Information Technologies
Specialization complementary Semester 6		Operations Research (IO)	Programming and Parallel Architectures (PAP)	Concepts for Specialized Databases (CBDE)	Operations Research (IO)	Distributed Applications (AD)
Specialization compulsory Semester 5	Interaction and Interface Design (IDI)	Graphics (G)	Operating Systems II (SOII)	Database Design (DBD)	E-business (NE)	Internet Protocols (PI)
Semester 4						
Semester 3	Operating Systems (SO), Databases (BD)					
Semester 2						
Semester 1						

**Table 12.** Selected dimension and levels for each course

Dimension	Level 1 Knowledge	Level 2 Comprehension	Level 3 Application
Efficient management of working time	SO, BD, NE	BD, DBD, PI, CBDE	IO, NE
Respect	BD, IO	AD, PAP	DBD, CBDE, NE
Rigor in achieving the technical competencies of the course	IO	BD, SOII, DBD	SO, DBD, G, AD
Motivation	BD, CBDE, IO	PI, AD, NE	SO, SOII, DBD, PI, AD, CBDE, G
Ability to identify shortcomings and aspects to improve	BD, CBDE, IO	BD, DBD, CBDE	SO, SOII, DBD, PI, AD, CBDE, G
Responsibility in learning	SO, PI, AD, PAP, CBDE, NE	BD, DBD	IDI, SOII, NE
Active interest in obtaining quality results	SO, BD	IDI, SOII, PAP, AD, CBDE	AD, PAP, IO, NE, CBDE
Capacity to adapt to organizational and technological changes	IO	IDI	SO, BD, IDI, SOII, DBD, PI, AD, PAP, CBDE, G, IO, NE
Professional realization	PAP, CBDE, G, SOII, AD, IO	IDI, DBD	AD, PAP

shows the selected dimensions and activities for the BD course.

As a result of the application of these activities, some grades are obtained as Table 14 illustrates. Grade A means excellent, B good, C sufficient, D deficient and NA not applicable.

Sometimes the grades can be obtained automatically, for example the grade for *Theory/Exercises Improvement* is obtained as the average of the grades of the activity *Group Review*. In other cases, the grades are the impression of the teacher on the dimension, for example the grade for *Theory/Exer-*

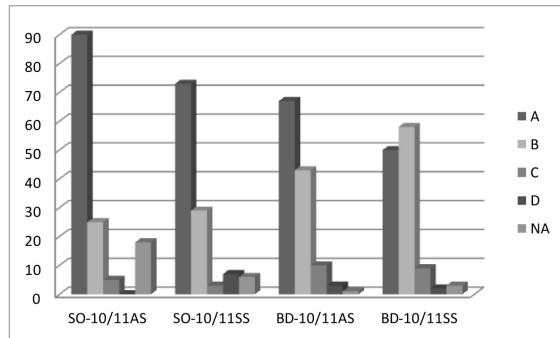
**Table 13.** Activities for the selected dimensions of BD

Dimension	Level 1 Knowledge	Level 2 Comprehension	Level 3 Application
Efficient management of working time	Short question at the beginning of the class	Teamwork with cooperative learning techniques	
Respect	Teamwork with cooperative learning techniques		
Rigor in achieving the technical competencies of the course		Pass all the computer tests proposed	
Motivation	Teamwork with cooperative learning techniques		
Ability to identify shortcomings and aspects to improve	Teamwork with cooperative learning techniques	Group review	
Responsibility in learning		Autonomous learning work for theory, exercise or laboratory classes	
Active interest in obtaining quality results	Understanding rubrics		
Capacity to adapt to organizational and technological changes			Exercises with time and resource constraints
Professional realization			



**Table 14.** Table to obtain the BD course grades for the generic competency

Name	Group	THEORY/EXERCICES						LABORATORY						FINAL GRADE		
		Time	Responsibility	Motivation	Improvement	Respect	Rigor/Quality/Constraint	T/E GRADE	Time	Motivation	Improvement	Respect	Rigor/Quality/Constraint		L.GRADE	
Student 1	G11	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Student 2	G11	A	A	B	A	B	A	A	A	A	A	A	A	A	A	A
Student 3	G11	A	A	B	A	C	B	C	A	A	A	A	A	A	A	B
Student 4	G11	A	A	B	A	B	B	B	A	A	A	A	A	A	A	B
Student 5	G11	D	D	NA	D	NA	D	NA	D	D	D	D	D	NA	NA	
Student 6	G11	A	B	B	A	D	D	D	B	A	A	A	A	A	A	C
Student 7	G11	A	A	B	A	A	B	A	A	A	A	A	A	A	A	A
Student 8	G11	D	C	D	C	D	D	D	B	B	B	B	B	B	D	



**Fig. 1.** The course grades during 2010/11 semesters.

*cises Motivation* is obtained using some teacher notes taken during the activity *Teamwork with Cooperative Learning Techniques*. The grade of Theory/Exercises and Laboratory is calculated using a formula that gives different weights to the grades of the activities. The final grade is, approximately, the average of the Theory/Exercises and Laboratory grades.

#### 4. Results and discussion

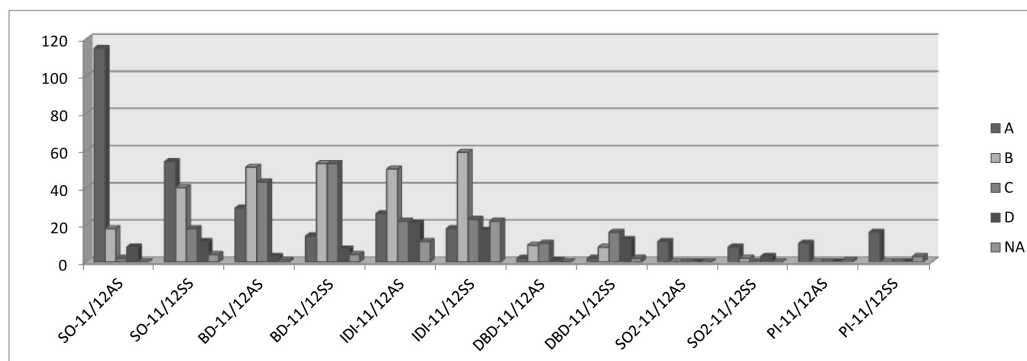
Before the EHEA the university curricula were centered on the learning of the technical competencies. The CDIO initiative [32] noticed a lack between the needs of the professional environment and the academic environment, especially in engineering curricula. The CDIO initiative and the Tuning project promote the incorporation of the generic competencies into the EHEA. In this section, the

grades obtained during six semesters for the different courses will be presented and discussed. However, these grades cannot be compared with previous grades since before the EHEA; the generic competencies were not assessed.

The BDCE implementation was done gradually. In first semester the basic compulsory courses and so on. SO and BD start Autumn Semester (AS) of 2010/11. Fig. 1 illustrates the grades obtained for the SO and BD courses during 2010/11 semesters.

The first year of implementation has a clear tendency to evaluate students with the highest grades. Probably, this is due to the lack of experience of the teachers in assessing generic competencies. IDI, DBD, SO2 and PI start AS of 2011/12, as Fig. 2 shows.

After two semesters of experience in the competency assessment by teachers and having solved the problems found during this period with the coordinator of the competency, the second year of SO and BD shows a normalization on the grades. The number of B and C grades is higher than A in BD. The number of A grades decreases in SO, but continues to be high. The reason may be that the courses develop the competency at three different levels of maturity (SO at level 1, BD at level 2 and the rest of the courses at level 3). That implies the activities in SO are very simple and probably the reason for the good grades. IDI has an evolution similar to BD. Only SO, BD and IDI are compulsory courses and have a large number of students enrolled (about 200). The rest of the courses have between 10 and 40 students. When the number of



**Fig. 2.** The course grades during 2011/12 semesters.

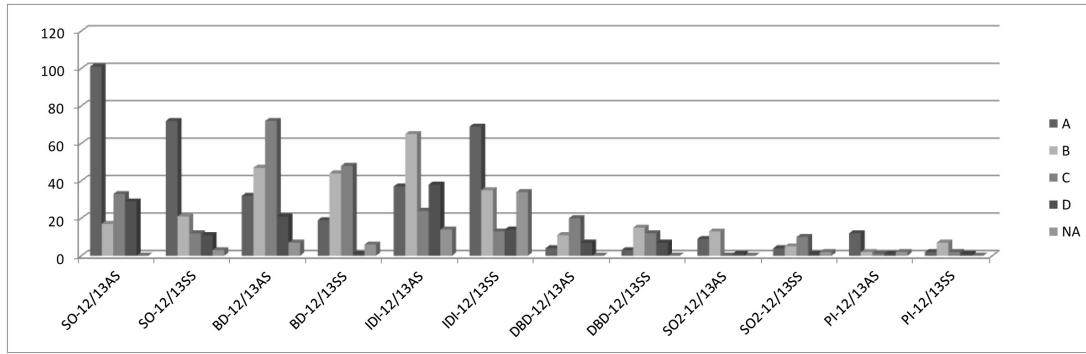


Fig. 3. A first group of course grades during 2012/13 semesters.

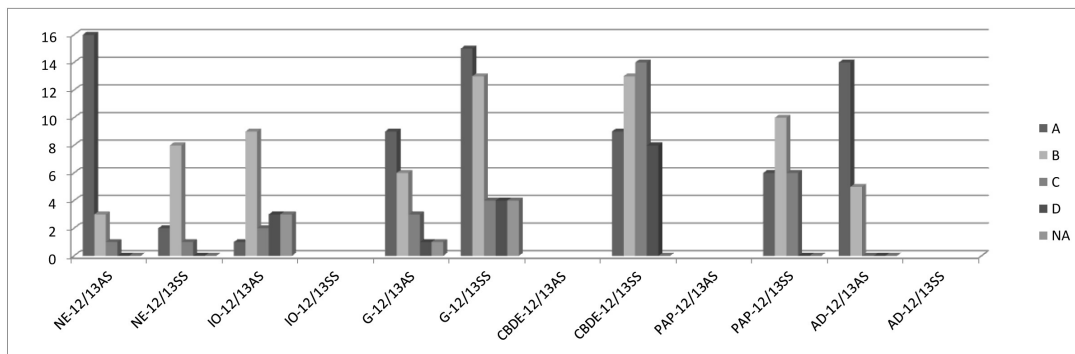


Fig. 4. A second group of course grades during 2012/13 semesters.

students is lower and there is higher student interest in the course, then the grades are higher.

Figure 3 illustrates the grades obtained for SO, BD, IDI, DBD, SO2 and PI during 2012/13 semesters.

Finally, during 2012/13 the rest of the courses were offered, as Fig. 4 shows. Specialization complementary courses, such as IO, AD and PAP are offered only one semester per year and CBDE starts Spring Semester (SS) of 2012/13.

Besides the quantitative results of the grades, in the SS of 2012/13, 93 students of the BD course answer a qualitative short poll about their impression about the acquisition of the competency.

The poll propositions were:

1. Teamwork with cooperative learning techniques helps me to promote a proactive attitude and respect to my team-mates.
2. Teamwork with cooperative learning techniques improves my positive interdependence.
3. A short question placement at the beginning of the class motivates me for assistance and punctuality.
4. Autonomous learning makes me more responsible.
5. Use of rubrics helps me to improve rigor and quality.

The answers were selected from the range composed by: 1 (completely disagree), 2 (disagree), 3 (medium), 4 (agree) and 5 (completely agree).

In Figs. 5, 6, 7, 8 and 9, the graphics with the results of the poll are shown.

The answers of the poll corroborates that students are satisfied with the activities of the competency and they feel the improvement in their attitude. The only exception is the question 4, which is not especially low, but may indicate a

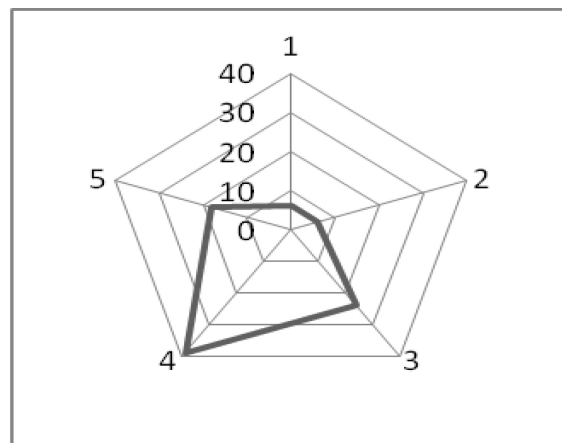


Fig. 5. Question 1 answers.

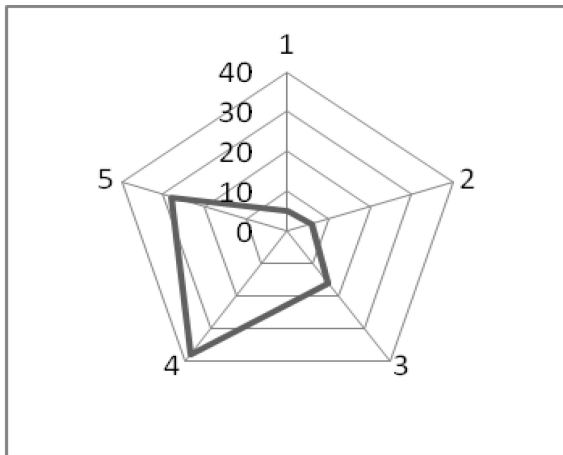


Fig. 6. Question 2 answers.

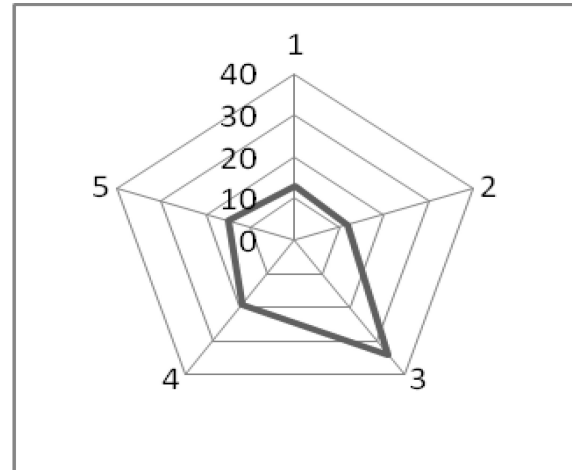


Fig. 8. Question 4 answers.

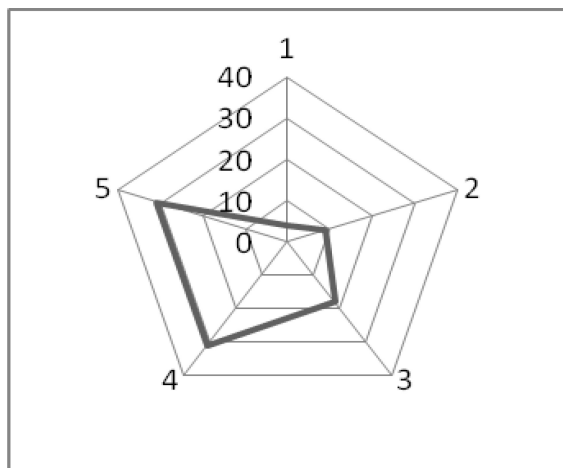


Fig. 7. Question 3 answers.

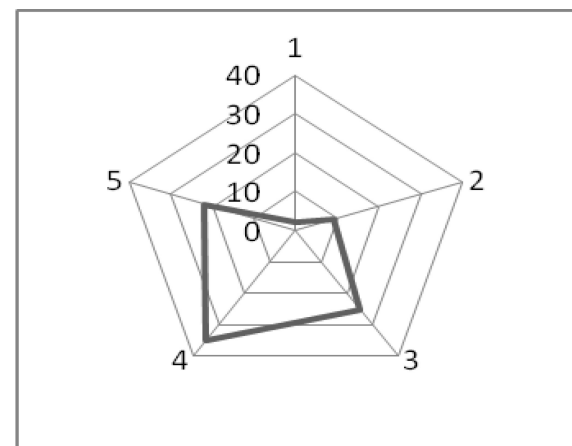


Fig. 9. Question 5 answers.

problem. Although the autonomous learning activity was designed to strengthen the responsibility dimension, it is possible that students do not experience it this way and this gives the competency coordinator the idea that this activity should be improved or changed. This pool will be repeated in subsequent semesters and in all the courses with the competency assigned to detect shortcomings and aspects to improve.

## 5. Conclusions and future issues

This paper has presented a proposal to develop and assess the generic competency of appropriate attitude towards work. The competency has been defined and their map has been proposed. Moreover, the activities to achieve the competency and a procedure to evaluate it using them have also been explained. Finally, the experience of six semesters integrating activities in the degree program has

presented and discussed. The methodology and experience presented in this paper can be useful to other universities that are considering the implementation of the generic competencies in their degrees.

Further work is planned to obtain a more accurate qualitative measure of the achievement of the competency and specially how to solve the problem of students that do not progress appropriately in the acquisition of the skills and/or with a low level of participation in the different activities.

The initial feedback from the teacher's interviewed after six semesters of experience is fairly positive. The idea of incorporating activities about the competency has been very well accepted. A detailed analysis of the teacher's satisfaction including a qualitative study will be carried out as a future work. Moreover, some teachers have noticed that an appropriate attitude in the academic environment also improves the course grade and that is another topic to be in-depth developed.

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