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Innovative Evaluation by Projects for Course with Mixed Computer Science Degrees*

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This paper explains the evaluation method applied to a specific capstone course, called "Ubiquitous computing", taught in different Computer Science Degrees of the University of Alcalá (Spain). Along the previous editions of the course several issues have been discovered, which are intended to be solved with the proposed method that was used as evaluation system of the subject in year 2016–2017. The issues are related to the number of students of each degree that compose the group each year, the contents' deviation, the low marks obtained in previous years, the methodological mismatch in relation with other subjects and the bad alignment of the evaluation method used before. With the idea of obtaining better marks, a closer experience to the real situation in software companies and higher satisfaction level of the students, the learning experience proposed implies teamwork, a project-based learning perspective and a balanced use of the technologies. Taking the results obtained through its implantation along the last academic year, it can be concluded that the evaluation method shown in this document enhances the learning process and the contents are closer to the course initial conception, and students got more involved and obtained better results.

Keywords: education; collaborative learning; project-based learning (PBL); evaluation methods

1. Introduction

Learning process is as important as complex due to the amount of factors implied, including a lot of encouraging and discouraging student factors that reflect the student-dependent nature of approaches to learning (age, gender, intellectual ability and level of cognitive development, personality, previous experiences, learning habits, preferences for teaching methods, motivation, etc.) [1]. Factors like students' profile and motivation, contents, tools, methodologies, teachers' knowledge and society, evolve continuously generating the necessity of applying efforts to keep higher the proficiency or to enhance it whenever needed or possible.

In order to improve the learning process, the courses must take the evaluation results and use it to redesign the training program to be more aligned with actual work practices [2], through a continuous improvement that enhances motivation levels and learning performance.

In this paper the authors are showing their approach to enhance the results of students of one course where the mixed profile of students endangers the results. This year, the risk of worsening increased due to the addition of the legibility of the course to another degree and it seemed to be recommended to take some actions to shift the challenge into an opportunity to enhance results adapting the teaching methodology and the evaluation techniques.

For this work it was selected a capstone course. They typically come at the end of a sequence of courses with the specific objective of integrating a body of relatively fragmented knowledge into a unified whole. Usually, this sort of courses aims of provide an experience where undergraduate students may look back over their undergraduate curriculum in the effort to make sense of that experience. [3].

About the methodology used, the teachers of the course have used the classical approach in previous courses, but we can see that "Mismatches exist between common learning styles of engineering students and traditional teaching styles of engineering professors. In consequence, students become bored and inattentive in class, do poorly on tests, get discouraged about the courses, the curriculum, and themselves, and in some cases change to other curricula or drop out of school" [4]. This course is available in the last year of degrees where the learning style of students could be more dramatically different from classical one and it could be more profitable to change into a modern teaching approach using e-learning tools, collaborative learning and innovative evaluation.

In Table 1 the different types of learning styles can be observed, which classify students according to the ways they receive and process information; and teaching styles, that classify instructional methods

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Table 1. Dimensions of Learning and Teaching Styles [4]

Preferred Learning Style		**Corresponding Teaching Style**	
Perception	Sensory Intuitive	Content	Concrete Abstract
Input	Visual Auditory	Presentation	Visual Verbal
Organization	Inductive Deductive	Organization	Inductive Deductive
Processing	Active Reflective	Student Participation	Active Passive
Understanding	Sequential Global	Perspective	Sequential Global

according to how well they address the proposed learning style components.

This is a relevant matter, because the selected teaching styles could impact dramatically in the course development and must fit to the preferred learning styles of the students. For example, if students prefer intuitive over sensory perception, they would respond better to abstract contents rather than concrete contents.

According to different surveys performed about capstone courses [5, 6], most of the evaluated cases are composed by class and project design in parallel, where the most usual is a medium-sized group of 4–6 students per project [5]. This approach of capstone courses is growing in time regarding to other alternatives where the courses without a project component are a very small minority. This result makes sense due to the alignment of this sort of courses with work practices [2] where aspects such as oral communication, engineering ethics, project planning or scheduling and teamwork are essential [5].

Taking a look to the evaluation of this sort of courses, the study performed by Ada Hurst and Oscar G. Nespoli [7] shows how Instructor-only meetings provide more direct and relevant feedback than a mixed review where the students are also involved. This could have happened because teachers are generally more expert and experienced in these areas than students and, in most of the cases, the instructors have previous industry experience [6]. On the other hand, peer-review combine both the instructor's feedback, along with the students. In that way students can improve not only technical aspects but other as conceptual communication or teamwork's where is very important their perspective on other students' idea as potential users of the system.

So, the hypothesis in the base of this work is the following: In a course with increasing variety of students' profiles, innovative approaches for teaching and evaluation, could enhance the results of the group. For that reason, in this paper we have proposed a new method of evaluation based on a collaborative environment where students of different degree's profiles work together.

In the following sections of this paper, the characteristics of the course are presented and the degrees where the course was eligible in previous years and in the current one, are described. How the teachers face the new challenge of the mixed profiles of the students is shown and, finally, the previous approaches used in the evaluation are shown along with the new proposal for them. After presenting the situation and the actions performed, results are discussed, and conclusions are exposed.

2. Presentation of the course characteristics and context

Due to the wide range of knowledge included in Computer Sciences, its study at university is divided in different Computer Science Degrees. Thus, in cases of capstone courses it is important to know the differences regarding to the experience, skills, strengths and weaknesses of each degree in order to adapt the course for a better understanding. For that reason, this section shows an analysis of the different Computer Sciences Degrees offered at the University where the evaluation was performed. Also, in order to show the complete context of the situation, an explanation of the course where it was performed the evaluation is shown.

2.1 Computer science degree

The Computer Science Degree, also known as Bachelor of Computer Science (BSC), is a university study which emphasizes the mathematical and theoretical foundations of computing. In the case of the University of Alcalá (Spain), where the evaluation was performed, Computer Science Degree is split in three different studies named as Computer Science Engineering (CSE) [8], Computer Engineering (CE) [9] and Information Systems (IS) [10].

According to statistics, all those studies have high demand, with a total of 889 new students in 2015–

2016 course where 358 are CSE's students, 301 are IS's students and 230 are CE's students [11].

As most of Spanish degrees, all of them are 4 years long [12] where the first three years are composed of mandatory and core subjects and the last year is mostly composed by optional courses selected by students, practice in companies and a final degree project.

There are some the differences between the three degree's options. For example, CSE focuses in the core of the Computer Science subjects, CE focuses on the lower level programming for small computer systems and embedded systems and IS focuses on a more business based view of computer systems. As measure of the compromise with the core of computer science subjects, we can count the number of programming courses and find 5, 4 and 3 of them and we can see a bigger number of HW related courses in the case of CE and a bigger number of business related courses in the IS degree. If we perform the same analysis of programming courses in the different degrees, but this time regarding to the percentage of dedication on the total plan of studies, only taking into account the mandatory courses, it can be seen how in case of CSE the percentage of programming courses is 20%, while in CE is 14% and in IS 12%.

The main differences between those subjects are showed below:

- Fundamentals of Programming introduces students in the programming's world with no assumed previous knowledge. The subject teaches the software design process, and shows how to develop a correct, readable and reusable solution from a problem specification.
- Programming introduces students to the object-oriented programming paradigm, presenting the theoretical concepts associated with this paradigm as well as describe the techniques of object-oriented analysis and design.
- Software Development aims to introduce students to the object-oriented programming paradigm. The subject will present the theoretical concepts associated with this paradigm as a class, object, inheritance and association relationships, abstract classes and polymorphism, etc., as well as describe the techniques of object-oriented analysis and design.
- Data Structures studies data structures conceptually along with their forms of representation and their implementations. The student will also learn to build specifications of Abstract Data Types (ADTs) and also to implement these specifications using an object oriented programming language.
- Advanced Programming introduces new concepts and programming techniques that allow students to handle the creation of advanced applications that use concurrency, distribution and Mobile.
- Advanced Programming Extension develops content aimed at achieving an improvement in programming techniques known by students using the latest technologies. The course promotes understanding of the basics and seeks to analyze problems where a high degree of computational calculation is required.

2.2 Course characteristics

The course analyzed in this paper is "Ubiquitous computing" [19] and is a capstone course, term used to describe courses typically taken in the last years of the engineering curriculum, for students in the Computer Science Degrees of the University of Alcalá (Spain). Thereby, students apply the scientific and programming principles learned in the first courses to technological problems. This kind of course has a practical perspective, important for better prepared graduates for engineering practice [16]. The course takes place in the first semester which starts in September and finishes in February.

The aim of the subject is to introduce students to the current situation of people's immersion in smart environments with capacity of computation and communication. Those environments encompass ambient intelligence, pervasive computing, mobile computing and ubiquitous computing. The characteristics that define each one is studied along the course, performing complete projects of development. The creation of invisible technologies through sensors, triggers and circuits' boards of easy programming are also studied. The required develop-

Table 2. List of programming courses

Type of Subject	Year	Semester	Credits	CSE	CE	IS
Fundamentals of Programming [13]	1	1	6	X	X	X
Programming [14]	1	2	9	X		X
Software Development [15]	1	2	6		X	
Data Structures [16]	2	1	6	X	X	X
Advanced Programming [17]	2	2	6	X	X	
Advanced Programming Extension [18]	3	2	6	X		

ment methodologies adapted to this sort of tasks will be presented and introduced into the projects. The existing business models are also analyzed in order to select the most appropriate to each project.

3. Issues and proposal

Due to organization problems in the university, no students from CSE were allowed to get the course in previous years, having a composition, in the year 2015–2016, of 66.66% of students from IS and 33.33% from CE. This issue highlights how the content and evaluation methods for the course is strongly affected by the number of students of each degree that compose the group every year.

With a composition of students with opposite curricula and without students of core curricula, the real possibilities of implementing ubiquitous systems were very limited. For that reason, we decided to make a theoretical approach using mobile computing as a practical substitution for real ubiquitous computing. This deviation of the course content is labeled as issue 1.

The structure of the course consisted on an obligatory assistance of the classes, where the teacher gives the students a brief information about the topics and they have to perform practical exercises on the laboratory. Throughout the previous editions evaluation methods were limited to test assessments based on theoretical contents and mobile developments hand-in for laboratory evaluation. It is important to highlight that every year the maximum number of 25 allowed students is reached, but some of them fail the course and it seems that it is possible to enhance the number of students passing it.

In courses where the level of practice is high, the approach selected to teach and evaluate the results has an important role. In this aspect, it is usual to center this approach in a teamwork and project-based learning (PBL), taking into account the concepts revealed in "The Action Agenda for Systemic Engineering Education Reform Guidelines for Submission of Proposals" [21]. The PBL, applied as pedagogy model, enhance retention, student satisfaction, diversity, and student learning [22] and the collaborative learning through teamwork create more inclusive learning settings [23] and ease the course tasks, because there are several profiles (and degrees) implied in the experience, with different skills, strengths and weaknesses. This interdepartmental teams are often used in capstone courses [20].

Even knowing these facts, teachers of the course applied classical methodologies due to the differences in profiles from both groups of students, that made impossible to offer projects that could fit for both groups (CE and IS students). The marks of students and the number of students abandoning the course were very unsatisfactory. We had 25 students running the course, and 8 of them did not continue from about the 4th week. As positive asset we had that all the students following the course passed it and average of marks were 7.32. This could be a good result for the course, but if we consider the students that abandon as 0 score, the average decreases to 4.98. Marks and averages can be seen in Fig. 1. We can label this low level marks as issue 2.

This year, 2016–2017, the university finally allowed to the students of CSE to take the course and we got a composition for the group of 16% from CE (4 students), 40% from CSE (10 students) and 44% from IS (11 students), approximately. The teaching methodology and the evaluation process applied to the course must take into account the "Teaching Techniques to Address All Learning Styles", proposed in [3], in order to enhance the quality of the training provided to the students. Classical methodology, used in the course in previous years, can't address many learning styles even

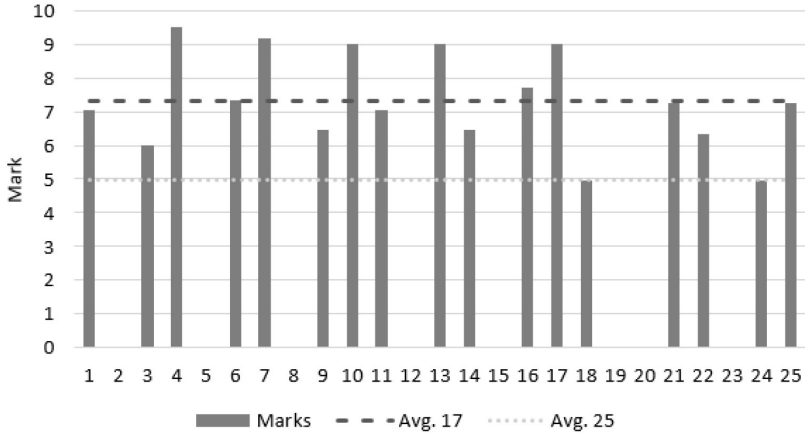

Fig. 1. Year 2015–2016 marks and average of 17 and 25 students.

Table 3. Detected issues

Issue 1	Course contents deviation
Issue 2	Low marks' level
Issue 3	Mixed profiles
Issue 4	Methodological mismatch
Issue 5	Bad alignment of evaluation

less with more profiles. We can label the mixed profiles of students as issue 3 and the methodological mismatch as issue 4.

Related to issue 1 and 2, the evaluation of the performance of students and the distribution of grades, which is the most difficult task of instructors [20], must be review to enhance the results and to fit with new methodologies. Bad alignment of the evaluation is labeled as issue 5.

Once detected the main issues with the course and studied the possibilities, course teachers decided to adapt the methodology and the evaluation trying to take into account the ''Teaching Techniques to Address All Learning Styles'', proposed in [3]. These changes can address all detected issues showed in Table 3.

The main methodological modification consists on moving the focus from teachers' classes into student activities. The teachers will use the first two sessions to present the technology and from that moment, they modify their role into advisory and guide. The activities proposed to students consist on questions to answer by the whole class using forums with individual posts, a framework to develop ubiquitous computing projects to be proposed by groups of students and the agenda for presentations. On Table 4 it is shown the main modifications of the course, the expected effect of them and the issues addressed by every modification.

We can see that these modifications to classical evaluation process transform the course into a collaborative environment, where students of different degrees must interact. This cooperation was divided into three steps: the individual forum cooperation to set up the initial knowledge needed for the course, the working groups' composition in heterogeneous groups and the ubiquitous projects developed in class.

3.1 Forum cooperation

Using e-learning systems in education is becoming, without doubt, a more and more used learning method. This is due to the interaction in online learning programs promotes student-centered education, encourages wider student participation, and produces more in-depth and reasoned discussions than traditional face-to-face programs [24, 25].

In this aspect, the use of online discussion forums as pedagogical platform allows students to work together, participate in on-going discussions focused on course content, and to present group projects to the rest of the class. Among the advantages of its use is the possibility of accessing the information independent of student location and the possibilities of participation in the discussion forum independent of the hour. Besides, all postings are public and archived, so they can be re-viewed as needed and readily accessible to all participants. This written record may be considered as a body of knowledge collectively written by the course's participants.

In addition, online discussion forums provide opportunities for responsibility and active learning through the regular participation [26], demanding that students become actively engaged with the course content, constructing knowledge through the shared experiences that each participant brings to the collaborative discussion [27]. For that reason, the use of online discussion forums was used along the course as a phase of cooperation between

Table 4. Modifications to the course and expected effect

Modification of the course	Expected effect	Issue addressed
Big groups of students for project development	Allow big projects, multiple roles and full set of activities	1, 3
Mandatory mix of profiles in every group of students	Simulate real working groups and force students to interact in base of capabilities and not personal affinity	3
Technical questions on BB(*) forums	Make students look for information and build their own knowledge	2, 4
Preparation and public presentation of reports about BB activity	Make students to justify their individual work and their interest on other students posts	4, 5
Project proposals from students groups	Let the students and force them to find good proposals based on their self-built knowledge	3, 4
Mandatory questions asked from all groups to presenters	Make students collaborate in the whole process of the course with this intervention in the evaluation of the work of other groups	3, 5
Evaluation of presentations, individual activity on BB, group work and questions	Let the teachers evaluate a wide range of activities that show the implication of students with the course	2, 5

(*) Blackboard online campus.

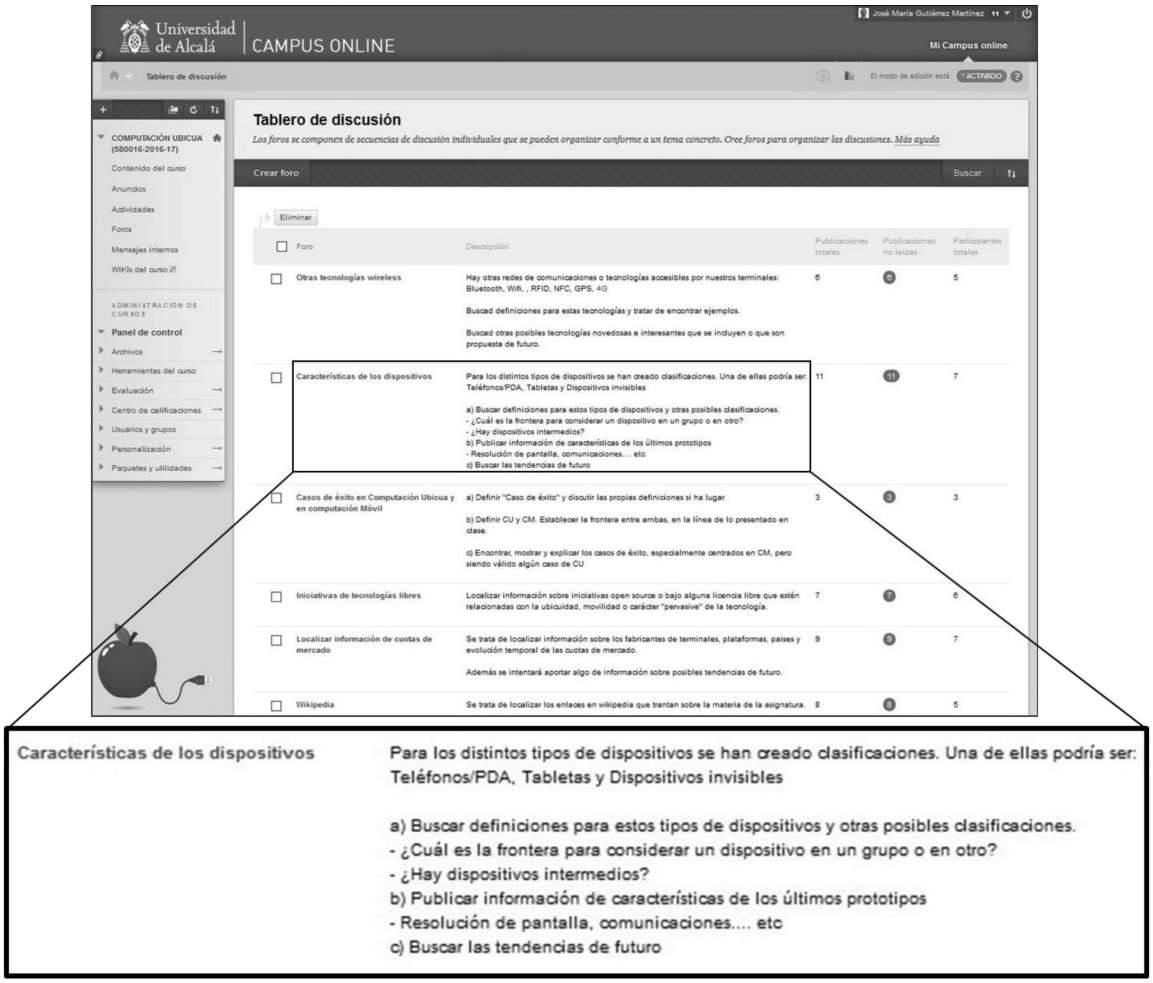

Fig. 2. Online discussion forums' platform.

students and to promote the commitment to the subject. Fig. 2 shows the online discussion forums' platform used along the course.

In the year 2015–2016, for the cooperation phase, the teachers created 8 forums, 2 of them with administrative information about the course and advice, and the other 6 covering course contents from general Ubiquitous computing to wireless, applications market, methodologies or user interfaces issues. Besides, it was offered to the students the possibility of proposing additional forums. The student did not propose new subjects. During this year, the use of forums was not obligatory for complete the course. This limited its use, due to most of students used it basically as a tool to be informed, showing little participation and collaboration with their peers. In face of this issue, and to promote collaboration between students, we decided to make this activity mandatory.

In this year (2016–2017) the use of the forums was mandatory. Students must to participate in active way proposing new information or answering other students' issues. Teachers proposed 16 forums, 2 of them with administrative and advice, 14 of them with course content related subjects. Students proposed additional subjects and 5 forums were added to reach the final number of 21 forums. To help students to understand the relevance of cooperation and to make them to participate in forums, it was included as a piece of the evaluation of the course. They must create a report showing their contributions and, to make them read and value the work of other students, write about the most relevant posts from others and justifying the impact in their knowledge. The report was presented to the whole group. This session was very interesting as they could see how their work was valued and helped others to improve. Table 5 shows the differences on students' participation between both years.

Table 5. Differences on forums' student participation

Year	Number of forums	Students	Number of Posts
2015–2016	8	18	43
2016–2017	21	23	132

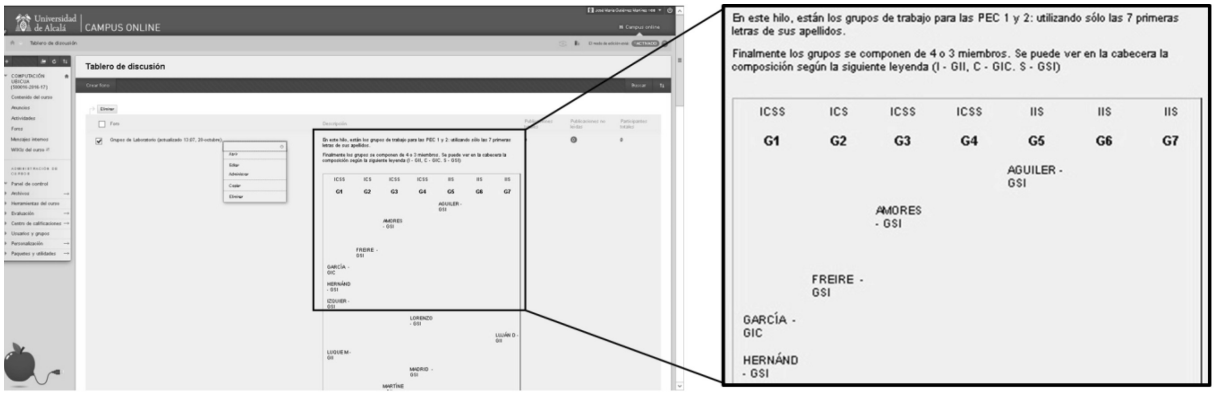

Fig. 3. Forum post with groups and members.

Table 6. 2016–2017 groups composition

Groups	CSE	CE	IS	Total
G1	1	1	2	4
G2	1	1	2 (–1)	4 (–1)
G3	1	1	1	3
G4	1	1 (–1)	2	4 (–1)
G5	2		2	4
G6	2		1	3
G7	2		1	3
Total attending students	10	3	10	23

3.2 Groups composition

The composition of groups is a decision to consider every year. Despite that in previous editions of the course the only requisite to conform the groups was the number of students per group, being the students the responsible to conform them. However, it is needed to consider the different degrees' skills. In this aspect, students of IS as less technological and CE and CSE similar in technological skills. Due to the aim of a capstone courses is to provide an experience where undergraduate students as close to the reality as possible, we decided that groups with mixed skills may be a positive experience.

As the number of CE students is very low (4), it is not possible to create groups with all the profiles in their composition, because the preferred number of students is 3 or 4 to reduce the coordination problems. With 25 students we can create 6–8 medium-sized groups formed by 3 or 4 students. If we sum CE and CSE students we get 14 and the best distribution will be in 7 groups, with two CSE members or one CSE and one CE members. We completed the groups with one or two members from IS, selecting all of them with the alphabetical list. Then we published the list of groups in forums with first six letters of the family name of the students and their degree. In Fig. 3 it can be seen part of this post.

The publication of groups' composition started a period of a week to allow students to propose changes, with the condition of maintaining the percentage of participation of every degree. This phase also allowed to check for students that were not compromised with the course and to ensure that all groups have enough member of the proper degree. The initial composition of every group and the students that were not able to follow the course are showed in the Table 6, where we can see that the final number of students in the course was 23.

3.3 Groups projects

Once the groups were created they started to develop their ubiquitous projects. The first step was to set up one or more proposals to discuss with teachers and to select one of them. The second step was to analyze the market, the methodologies, the platforms and, finally to make a whole development proposal. These proposals were presented to the class where questions from other groups where mandatory. Table 7 shows the project's proposal performed by the 7 groups.

After presentations, projects were revised and with this final proposal they started the development. During the development process, teachers acted as advisory and before Christmas, there were meetings with every group to ensure the proper evolution of projects. At the end of the course the final presentation of project took place and, again, students' questions were mandatory and recorded by teachers. All groups were able to produce functional prototypes as we can see in Fig. 4.

3.4 Evaluation of the course

Although in previous sections the evaluation method has been partially described, we need to make a complete description of it.

Due to the aim of this sort of courses is to provide an experience where students may look back over the skills obtained along the degree, the presence of a project looks as mandatory. This project will be

Table 7. List of 2016-2017 groups' projects

Group	Project's Name	Project's Description
G1	Smart Coat	Intelligent coat equipped with sensors and heaters that turn on in low temperatures
G2	AutoVol	Device to adjust the volume of the music according to the external noise
G3	Handymouse	A ubiquitous device that simulates the behavior of a mouse through a glove
G4	Bat-Cane	Smart cane to detect obstacles to help visual disabilities
G5	Sonar Multidireccional	Wearable that can be adapted as helmet designed to help visual impaired people to detect obstacles
G6	GAPSS (Gafas de Ayuda a Personas con Sordera Severa)	Prototype of transcription from audio to text which will be implanted on glasses to help in translation between 80 different languages
G7	iGlass	Glasses that can detect obstacles, emitting a beep when the user is close to them, easing the movement to users with visual disabilities

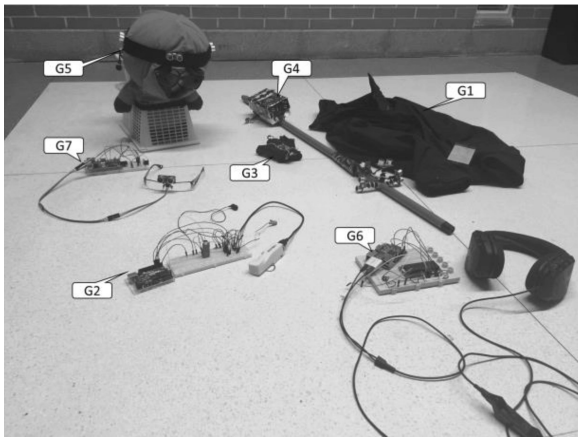

Fig. 4. Final prototypes.

combined with classes in parallel, as well as the presence of a forum of cooperation where students can share interesting topics with students.

Considering the teamwork approach of the course, the teachers decided to include peer reviews in the evaluation process, due to peer reviews allow to assess individual contributions to team efforts [28], allowing team members to evaluate the magnitude and quality of each of their classmate's work giving also their perspective on other students' idea as potential users of the system [6]. However, in view of the fact that sometimes the students' compromise with this sort of peer review contribution is lower than expect, it was decided that in this course the participation in some tasks will be mandatory to pass the course.

As a resume, the evaluation is formed by:

- Forums interaction (and the report of it uploaded to Virtual Classroom).
- Forums report presentation (and answers to classmate questions).
- First project presentation (and answers to classmate questions).
- Last project prototype presentation (and report of it uploaded to Virtual Classroom).
- Questions made to classmates, in forums and projects presentations.

Although this evaluation seems complex, as a result the students feel very comfortable with it as they follow the steps in a natural flow. From the point of view of teachers, this sort of evaluation may look like it requires an extra effort. However, the points where teachers need to make higher effort is the evaluation of the uploaded reports of forum interaction and project prototype. The other points of the evaluation, as presentations or questions, allow to support the final decision, being able to reward those students with a greater commitment to the subject, and most of them are gathered during presentation sessions.

4. Discussion

The results of changes on the evaluation and the whole learning approach must be evaluated in quantitative and qualitative terms. To do this, we need to consider objective results as marks and subjective results (hard to measure) as students' participation, compromise and satisfaction using surveys.

Despite it is difficult to perform an evaluation relative to subjective results, it is possible to see some differences regarding both years. This year, students have participated more, shared knowledge more, helped each other more, learned more and got higher satisfaction. These asserts could be hard to demonstrate but we will try to justify these teachers' feelings in this section.

First of all, we need to consider that the number of students attended classes was really high (>90%), all projects reached their final status and presented working prototypes and some students get marks higher than 90%.

If we focus on the number of students who finish the course, it is possible to see differences. Starting from the fact that in both years the number of students was the same, 25, along the year 2015–

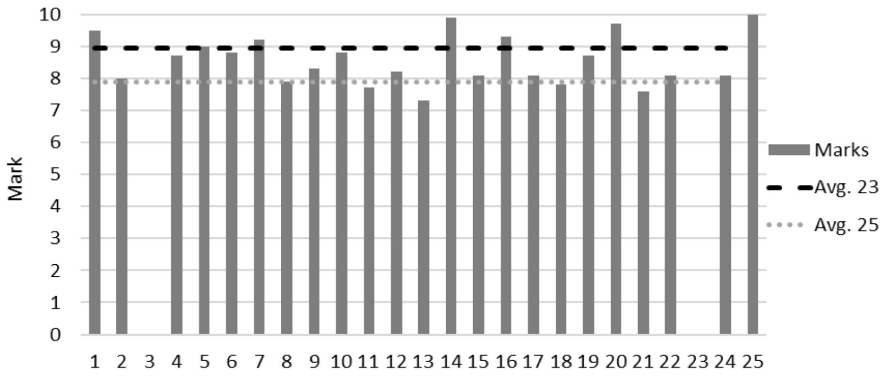

Fig. 5. Year 2016–2017 marks and average of 23 and 25 students.

2016 only 17 students finalize the course, and 8 of them did not continue from about the 4th week, which highlight a very unsatisfactory level of abandon. However, in case of the year 2016–2017 the number of students who leave the subject was lower, only 2 withdrawals.

If we compare the results on forums' participation between both years, it is possible to see how in the year 2016–2017 the student's participation was higher, with an average of 5.74 post per student instead of 2.39 post per student of the previous year. Besides, if we analyze the number of new forums proposed by the students, again the participation is higher in the last year, where 5 new forums were proposed by students with new topics related with the subject, meanwhile in the previous year there were no new forum proposed by students. This fact reflects how the student's implication on the subject was higher than previous year.

Regarding to marks, it is possible to see new differences between both years. During the year 2015–2016 we had that all the students following the course passed it and average of marks were 7.32. However, if we consider the students that abandon as 0 score, the average decrease to 4.98 as is shown in Fig. 1. On the other hand, if we perform the same analysis to the year 2016–2017 the marks were higher, with an 8.5 if we considered only the students following the course, and 7.87 if we considered the abandon as 0 score. The Fig. 5 shows the marks on year 2016–2017.

As additional information about course enhancement we decided to run a Likert-based survey on the course and made data analysis. One of the most important aspects that must be evaluated is related to the students' satisfaction. As a result, is it possible to check how the level of satisfaction with the subject is high, with a mark of 4.3 of 5.

Finally, we look back to the issues detected on the course to evaluate their evolution with the course changes. It is possible to check how this new methodology of evaluation helps to solve the 5 issues detected along previous years. Regarding to the Issue 1, the combination of students of all the degrees allows to prevent course contents deviations happened in the past where the lack students of core curricula it was decided to make a theoretical approach using mobile computing as a practical substitution for real ubiquitous computing. However, with a mixture of students of the different degrees this year was possible to adjust the course to the real content.

About Issue 2, where was detected a low mark level, it was possible to check how this level has grown from 4.98, as average in year 2015–2016, to 7.87, as average in year 2016–2017. Also, this grown in marks is largely a consequence of a lower rate of abandonment.

Another issue, numbered as 3, detected in previous editions of the course was the problems of mixed profiles. This issue was solved by the creation of bigger groups and projects where the use of different profiles fits in the roles needed to manage project, develop, test and make presentations of the project and product.

Furthermore, a cooperative working environment helps to prevent the methodological mismatch, numbered as issue 4, due to students must to collaborate to their classmates sharing knowledge, first through forums, and then thanks to the cooperation in developing a project.

The last issue related to evaluation, is solved due to the change in the evaluation that is focused on indicators gathered during presentations, from forum cooperation and projects development. This gather is carried out during the whole course in a continuous evaluation.

5. Conclusions

As conclusion, we can state that the changes made in the course modifies its content to get it closer to the course initial conception, and students got more involved and obtained better results.

Another conclusion is that the good results obtained with this evaluation method point out the convenience of continuing with it in the next years, adapting it, if necessary, according to the evolution of the students' group. Besides, a mixed group of students from different degrees seems close to the reality that the students will find once they graduate.

An indicator of the interest of this proposed method is that after presenting the results, the University of Alcalá rewarded the teachers as a training innovation project, to consolidate the initiative, with a grant of 500€ to invest in new material to be used in upcoming courses.

In the next years, in order to be able to evaluate the results obtained by this methodology of work, we have planned to make changes related to the development of the projects. The first change alternative is to propose the same project to more than one group with different degrees' composition in order to evaluate their competences. Another possible change is to propose bigger projects to groups formed by more students. This could be a good experience due to this is a situation that is closest to the reality. However, it is possible to have problems of coordination between students, probably on practice and/or working. Another important change that can be addressed on future editions of the course is the use of coordination tools because they have not been given much importance despite it has been indicated that it would be good to use them.

Finally, we made the reflection that, even with the reduced number of courses of last year's degrees, if all courses use a similar approach to us, the novelty for students will be reduced, their initiative could be exhausted, and the results could not be as positive as they are in this course. This reflection opens an interesting new research line.

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