CONSIDERATIONS ABOUT THE RELATIONSHIP BETWEEN THE TIME DEDICATED BY THE STUDENTS AND THE ACADEMIC PERFORMANCE IN A COURSE ON DIGITAL ELECTRONICS

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Abstract

The delivery of new degree courses at the university means that subjects are designed so that students will spend a certain period of study, according to the credits which are assigned. The course Digital Circuits and Systems, which is taught in the first semester of second year degrees of Telecommunication Systems and Telematics Engineering at the EETAC (Escola d'Enginyeria de Telecomunicació i Aeronàutica de Castelldefels), has 6 ECTS, equivalent to about 150 hours of student's work.

In this paper we discuss the results that we have observed after having surveyed weekly (for a period of 14 weeks) the time devoted by the students to the subject. It includes presential class time, cooperative work time outside the classroom and individual work time outside the classroom. This experience has been applied to 41 students in the spring semester of 2012.

The development of this subject consists on applying PBL and cooperative techniques, which permit that students solve several complex problems around digital systems, while the teacher acts as a guide of the learning process.

After comparing the time spent respect to the overall performance obtained in the course by the students, we can conclude that, with few exceptions, there is a correlation between these variables, using both, parametric and non parametric statistical analysis.

The paper includes some recommendations to be taken into account in the design and planning of the exercises that have been solved during the course, in order to improve the study efficiency.

Keywords: Project Based learning, cooperative work, academic performance, continuous assessment.

1 INTRODUCTION

Students devote time to do the activities of a given subject depending on several methodological aspects. Different approaches to teaching, learning and assessment processes have a great influence on the time that students devote to workload [1].

In engineering courses, active learning is promoted by means of solving problems or projects (PBL) [2] with the aid of cooperative learning [3]. [4]. [5]. It consists on the instructional use of small groups for students to work together to maximise their learning and that of their mates.

Student's assessment is continuous and formative and it is mainly intended to promote the deep learning of the subject content while putting into practice the cross curricular competences described in the subject's learning objectives.

The present work outlines the methodology and continuous assessment applied in the subject of Digital Circuits and Systems (CSD) in the first semester of second year degrees of Telecommunication Systems and Telematics Engineering at the EETAC (Escola d'Enginyeria de Telecomunicació i Aeronàutica de Castelldefels). It includes a case study about the student workload and tries to describe its relationship with the academic performance achieved.

2 COURSE METHODOLOGY

Digital Circuits and Systems (CSD) is a subject that belongs to the first semester of second year degrees of Telecommunication and Telematics Engineering, at the EETAC. Students attend each

week to 5 hours of classroom work, for 14 weeks, 2 hours of which are done in a classroom in large groups (up to 40 students) and the rest in the laboratory in small groups (up to 20 students).

The course is planned to use teamwork to solve a series of practical "real-world" exercises [6] through which, by induction, they will learn the subject content [7]. To encourage the learning of a second language, all the assignments are written in english. All the information that students require to follow the subject is placed in the site http://digsys.upc.es.

During the Spring term of 2012 we have studied a course of 41 students divided into two subgroups (S1 and S2) with 21 and 20 students respectively. In subgroup S1 there have been formed 7 cooperative groups (of three persons each one) and in subgroup S2 there have been 7 groups (6 of three persons and one of 2 persons). Our experience suggest that cooperative groups of three members (or two instead of four, when it cannot be otherwise) is the best option to organise teamwork in our second year course.

The specific competences that are given in this subject are:

- Capacity for analysis and design of combinational circuits and synchronous sequential systems and the use of microcontrollers.
- Basic knowledge and application of VHDL (Very High Speed Integrated Circuits Hardware Description Language).

The exercises that are planned during the course in a PBL procedure, involve the following cross curricular competences:

- Third language (English).
- Effective oral and written communication.
- Cooperative work.
- Autonomous or self-directed learning.
- Efficient use of instrumentation equipment.
- Project management.

The continuous assessment of the different activities involved in the subject takes into account the following percentages:

- Exercises account for 30 %
- E-portfolio accounts for 15 %
- Application Project accounts for 20 %
- Individual tests account for 25 %
- Attitude and participation account for 10 %

During the 5 semesters (from autumn 2010) that this subject has been taught at the EETAC, students have usually expressed the opinion that the required workload is higher than for other subjects in the same course. However it is worth mentioning that student evaluations of instructor performance have been favourable [8].

The implementation of new bachelor's degrees in engineering at the UPC, attending to the EEES recommendations, has meant important changes in teaching methodologies and subject organization. For instance, let's focus on the student's study time in class and out of class. To enable horizontal coordination, school staff has to survey how much time students are devoting to each subject, so that they can formulate and organise better the activities that are carried out. In particular, in the subject Digital Circuits and Systems (CSD) we are used to survey the dedication time of the students at the end of each week.

Table 1 shows the instrument for collecting data that the members of each cooperative group have to fill in. It includes presential class time, cooperative work time outside the classroom and individual work time outside the classroom.

Table 1: Instrument for collecting the dedication time of the students to the subject CSD (only three weeks are indicated).

Group Nº Group members A: B: C:	Classroom and laboratory (hours)	Out of classroom in group (hours)	Out of classroom individually (hours)
Week 1 (February 27 – March 4)			
Week 2 (March 5 – March 11)			
Week 3 (March 12 – March 18)			

The procedure followed to collect the data of the dedication time has been that at the beginning of the last class of each week, the instructor has handed out the table sheet (Table 1) to each group and students have been given 5 minutes to complete it. Once done, instructor has handed in the sheets. At the end of the course data from 14 tables were processed to determine study time.

3 RESULTS AND DISCUSSION

For each student we have calculated the average number of hours per week devoted to the subject. Fig.1 shows the box plot of the distribution, obtained by means of the statistical package SPSS Version 19. It can be seen that in subgroup S1 the median is 8.56 , slightly less than in subgroup S2 (10.19). The average values and standard deviation are (M = 7.90, s = 3.84) in S1 and (M = 10.25, s = 3.27) in S2. If we compare these independent average values by means of the parametric analysis (Student's t-test) and non-parametric analysis (Mann-Withney U test) they show no significant differences between the means and medians of these two subgroups. For this reason they can be treated as homogenous.

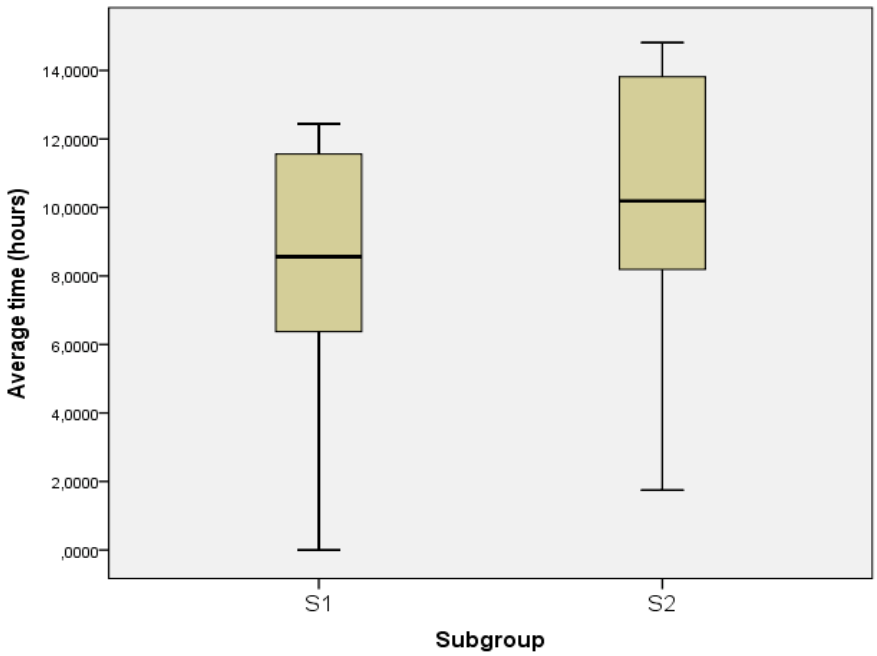

Figure 1: Box plots that represent the weekly average time devoted by the students of each subgroup to the subject CSD.

In the same manner Fig.2 shows the box plots, which depict the final mark of the students of each subgroup. In this case we can observe several outliers.

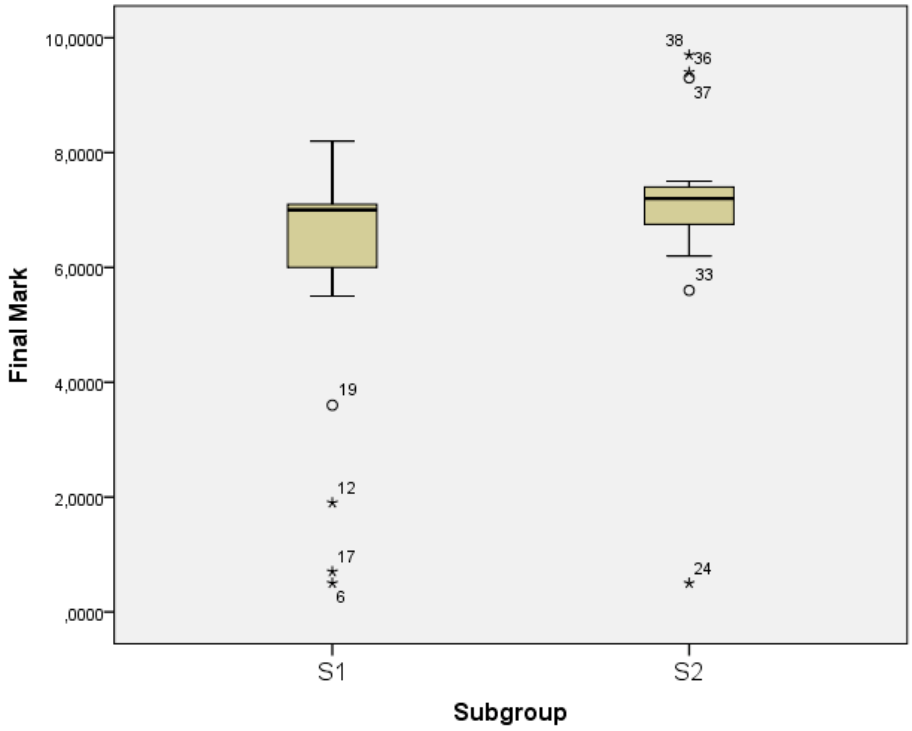

Figure 2: Box plots that depict the average final marks obtained by the students of each subgroup to the subject CSD.

As can be seen in Fig.2 the median is slightly greater in subgroup S2 (7.20) than in S1 (7.00). In this case the average values and standard deviations are (M = 5.91, s = 2.28) for S1 and (M = 7.01, s = 1.85) for S2. If we compare these independent means with a parametric analysys (Student's t-test) and non-parametric analysis (Mann-Withney U test) they show no significant differences between the means and medians of the two subgroups, which permit treat them as a whole.

From the graphs of Fig.1 and Fig.2 we can deduce that it could be a relationship between the time devoted to study the subject and the marks obtained by the students.

It can not be said in a categorical way that the best results in the academic performance of subgroup S2 is due to only have dedicated more time to study the subject, but it is a factor that has a high influence on this result. Other causes can be: motivation, interest, learning style, intelligence, etc.

To determine the objectivity of the registered time we have correlated the average time per student corresponding to the first half of the semester (7 weeks) with the average time per student of the second half of the semester (7 weeks). The Pearson's rho has been 0.800, with significance p = 0.01, and the Spearman's rho has been 0.808, with significance p = 0.01. These results don't guarantee the whole objectivity of the time that students have indicated, but maintains its trend, between two different periods of time.

Applying parametric analysis (Student's t test) and a non-parametric analysis (Wilcoxon test) for paired samples we have obtained no significative differences between the average values obtained in the first part of the semester (9.60 h) and in the second part of the semester (9.00 h).

Although correlations don't imply cause and effect [9] we have obtained the scattegram between the average of hours per week that each student has devoted to the whole subject and the final mark obtained. It can be observed that exists a high correlation (Pearson's = 0.827 and Spearman's rho = 0.616 with significance p = 0.01, n = 41). We can infer a great relationship between these two variables.

It is important to take into account that this is a case study and it has to be repeated in next semesters in order to determine its robustness.

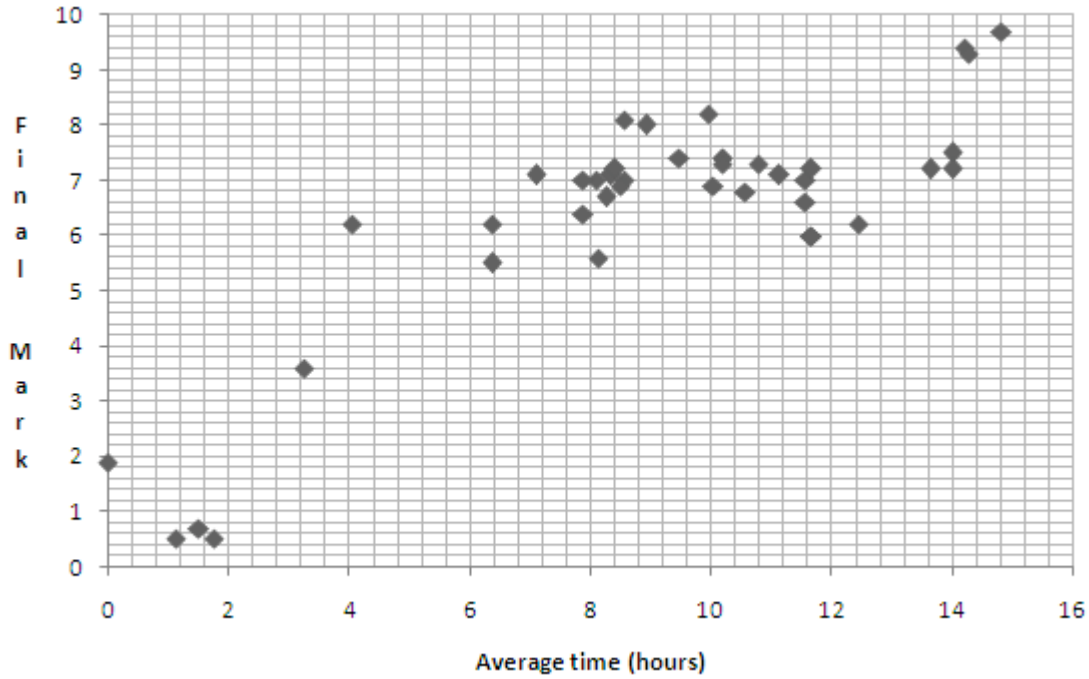

Figure 3: Scattegram of student final marks versus weekly average time devoted by each student to the subject, n = 41.

Although students consider that this subject has a higher workload than other subjects of the same semester, by means of this survey (Table 1) we have obtained a mean of 9,05 h per week (median = 9.47 h), with a standard deviation of 3.72 h. This value is smaller than the 10 h per week expected, which corresponds to the 6 ECTS.

Respect to the 6 exercises that students should solve, it has been observed that especially the last exercise and the application project should be less time consuming, because at the last three weeks is when the student workload is higher, due to the arrival of the exams and the due date of other assignments.

Respect to the study efficiency we have observed that some students take advantage of the work of their mates. In order to control this fact, we could randomly hand out a question, 10 minutes before the end of the class, about any important point treated in the current session. This approach has the collateral effect of forcing them to keep in the course track, which benefits to all class and reduce abandonment.

It is worth to note that it has been observed that most students who followed the subject until the end of the course passed it. Following the course means not only attending classes but studying regularly a great deal of the subject matter out of class autonomously.

4 CONCLUSIONS

This paper has outlined the current methodology and assessment which has been applied in the subject “Digital Circuits and Systems” in the Telecommunication and Telematics Engineering degrees from the (EETAC). The experience described corresponds to the Spring term of 2012, a period in which the authors of this work have studied two subgroups of about 21 and 20 students respectively.

Students were asked to indicate weekly how much time they had spent studying and making activities for this subject. Taking into account the information given by the students and the marks obtained, we conclude that they, in average, spend a mean of 9 h per week (median of 9.47 h), respect the average 10 h, expected by the official curriculum plan.

The parametric and non-parametric statistical analysis show that exists a significant correlation (Pearson’s rho = 0.827 and Spearman’s rho = 0.616, p = 0.01, n= 41) between the time devoted to study the subject and the final marks obtained. Further research should be carried out in future terms in order to generalize these results.

ACKNOWLEDGEMENTS

The authors would acknowledge the support of the GRAPA group of the project RIMA at the UPC.

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