Un modelo para estimar la distribución de la carga de trabajo del estudiante del horario conjunto

A MODEL TO ESTIMATE THE DISTRIBUTION OF THE STUDENT'S WORK LOAD FROM THE JOINT SCHEDULE

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RESUMEN

Una carga de trabajo desigualmente distribuida a lo largo de un semestre es uno de los factores cruciales que afectan el desempeño académico de los estudiantes universitarios. Las cargas de trabajo excesivas o distribuidas de forma desigual pueden dañar significativamente los resultados académicos y, lo que es más importante, determinar el enfoque de aprendizaje adoptado por los estudiantes. La coordinación horizontal tiene como objetivo garantizar una distribución racional de la carga de trabajo a lo largo de un semestre académico. Para ello, la Universidad Politécnica de Cartagena (UPCT) utiliza el 'Cronograma Conjunto', donde se agrupan las actividades planificadas por el profesorado para los diferentes cursos de un determinado grupo y semestre.

El objetivo principal de este trabajo es el desarrollo de un modelo que permita evaluar la distribución de la carga de trabajo del estudiante a lo largo de un semestre, utilizando la planificación inicial de actividades recuperada por la facultad.

Se han empleado varios enfoques para estimar la carga de trabajo del estudiante. Este trabajo se basa en la encuesta semanal de carga de trabajo realizada para varios cursos en una serie de grados de la UPCT, que ha permitido a los autores cuantificar la carga de trabajo del alumno medio para diferentes tipos de actividades, medir las actividades planificadas y simular el tiempo de carga de trabajo. Distribución de una actividad determinada en función del tiempo disponible para su realización.

Palabras clave: *Workload; horizontal coordination; mathematical models; schedule; academic management.*

ABSTRACT

An unevenly distributed workload along a semester is one of the crucial factors that affect the academic performance of university students. Excess or unevenly distributed workloads may significantly harm the academic results and, importantly, determine the learning approach adopted by the students. The horizontal coordination aims at ensuring a rational workload distribution along an academic semester. To achieve this, Universidad Politécnica de Cartagena (UPCT) uses 'Joint Chronogram', where the activities planned by the faculty for the different courses in a given group and semester are put together.

The main objective of this work is the development of a model that allows for evaluating the student's workload distribution along a semester, using the initial planning of activities retrieved by the faculty.

Several approaches have been employed for estimating the student's workload. This work is based on the weekly workload survey conducted for several courses in a number of undergraduate degrees at UPCT, which has allowed the authors for quantifying the average student's workload for different types of activities, for measuring the planned activities and for simulating the workload time distribution of a given activity as a function of the available time for accomplishment.

Once the planned activities are introduced into the chronogram for each course, the model computes and represents graphically an average-student's workload distribution, which depends on the type of activities and their distribution along the semester. This simulation allows for modifying the time-planning of the most critical activities, in agreement with the faculty, in order to ensure a more even workload distribution.

Keywords: *Carga de trabajo; Coordinación horizontal; Modelos matemáticos; Calendario; Gestión académica.*

1. INTRODUCTION

One of the most crucial factors on the academic performance of university students is the workload [1]. Excess or unevenly distributed workloads may significantly harm the academic results and, importantly, determine the learning approach adopted by the students [2], [3], [4]. The horizontal coordination aims at ensuring a rational workload distribution along an academic semester, avoiding peaks that might negatively affect the academic performance. To achieve this, two complementary actions must be taken:

1. Ensure that the workload assigned to a certain course in a semester is in accordance to the one specified in the official syllabus of the degree.

2. Plan the temporal distribution of the teaching and learning activities –particularly those linked to summative assessment– in order to avoid interferences between them, peak workloads and imbalances.

A wrong programming of activities causes a mismatch in the workload of the students, as a result of which some weeks of the semester will be overloaded with a huge number of tasks, whereas others will lack of any. A typical mismatch occurs at the end of the semester, incurring in high risks of stress for the students [7]. In addition, students frequently express the difficulties of an excess of workload during certain periods of their university studies, which incur in imbalances with other social responsibilities in their lives [8].

In order to ease the action 2), the authors report the use of the joint chronogram [9]. This chronogram records the singular activities –those beyond regular classes and lab sessions– that are scheduled by the faculty in all the courses taught in a given degree and semester. These activities include mid-term and final exams, submission of homeworks and reports, oral presentations and any other tasks that involve a significant workload to the average student.

Depending on their intensity, these activities are classified into four levels: low, medium, high and very high (the last ones for mid-term and final exams). The definition of an activity intensity is determined by the lecturer during a horizontal coordination meeting, on the basis of its description in the Teaching Guide.

The use of the joint chronogram allows to identify at a glance the days or weeks where two or more activities coincide, incurring in a possible excess of workload. The procedure for horizontal coordination would then search for a new plan of activities that avoids, to the extent possible, the detected overlapping.

In spite of properly defining the timeline of the teaching and learning activities, this kind of chronogram does not retrieve information on how the students workload is distributed: as different activities demand a different commitment, the average student will share his time up as a function of the planned timeline of activities. Accordingly, the procedure for horizontal coordination could be improved if we knew (figure 1):

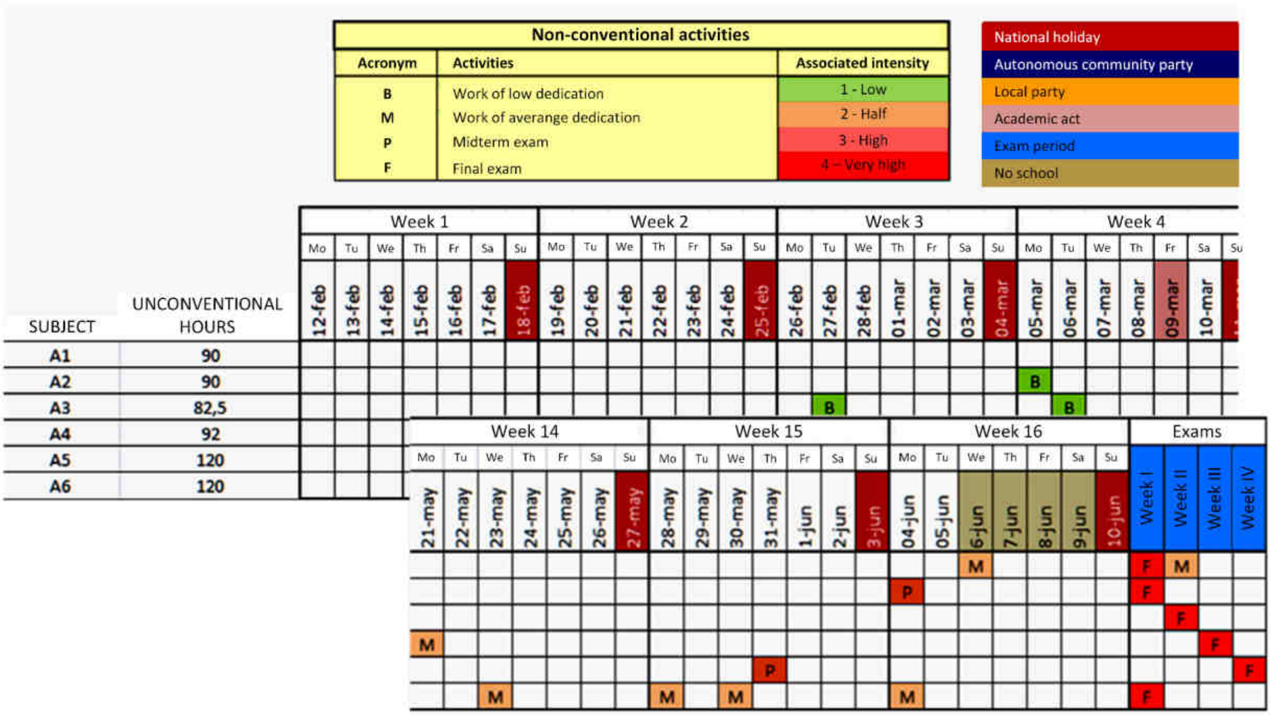

Fig. 1: *Example of a joint chronogram*

1. How will the workload of the average student be distributed for a given timeline of activities?

2. How will any changes in the plan of the activities affect the workload distribution?

This work aims at solving the two previous questions. The main objective is the development of a model to determine the workload distribution of the average student along a semester of the academic year. This model will use the initial chronogram of activities as an input, and could therefore be integrated in the procedure for horizontal coordination.

The student workload and its time distribution depend on several factors, and there is a number of methods to calculate it [5], [6]. The model proposed in this paper is based on the results of the weekly survey on actual workload, conducted among students of different courses and degrees at Universidad Politécnica de Cartagena (Spain). The results of the survey have assisted the authors in three aspects:

1. Quantify the average workload involved according to the kind of activities;

2. Assign values to the planned activities depending on their intensity;

3. Simulate the temporal distribution of the workload for a given activity, depending on the available time for dedication and on its interaction with other activities planned simultaneously in the same or other courses.

The perception of the workload by students is, among other factors, influenced by the evaluation scheme [10].

Once the activities of a course are introduced into the chronogram and their intensities have been determined, the model calculates and shows the simulated workload for an average student, which depends on the kind of activities and their intensity and distribution along the semester. The ulterior modification of the most critical activities in the timeline will allow to obtain an acceptable workload distribution. The final chronogram, as a result of the procedure for horizontal coordination, will replace the original one.

2. METHODOLOGY

The data employed in this work were obtained in a weekly survey conducted during a semester in twelve courses of different degrees and levels at Universidad Politécnica de Cartagena [11]. The survey questioned the students about the total number of hours invested per week in each singular activity registered in the Teaching Guide of the corresponding course. The classroom and lab teaching hours were not considered, but only those dedicated to the preparation of homework, reports, oral presentations, problem-solving, general study, etc. An example of the questionnaire employed, which includes different types of activities for each course, is depicted in figure 2. Apart from the columns that represent the fifteen school weeks of the semester, the questionnaire includes an extra column for the vacation period (Easter, in this example) and another for the final examination period.

The results of the survey allowed to analyze different aspects of the workload in the courses under study. Among these, the calculation of the total number of weekly hours employed by the average student to each kind of activity (see figure 3) and the workload distribution along the semester (see figure 4) are remarkable.

In order to scrutinize the relation between the joint chronogram and the workload distribution, the survey results obtained in four different courses were selected based on: the absence of outliers in the workload estimation done by the students; the absence of problems or complications during the data collection; and the sufficiently high population size. Table 1 contains the acronyms of these courses, the number of singular activities developed during each course and their intensity according to the teacher's judgement. The Timeline for the Course (TCM), for example, included a low intensity activity, a medium intensity activity and two high-intensity activities (namely two partial examinations).

Once the submission dates for each singular activity were defined, the average weekly hours dedicated to these activities were accomplished. The time employed by the students in tutorials, visits to the virtual classroom, etc, was not assigned to the singular activities, but took part of the students workload as "other activities".

The data collected for low intensity activities is shown in Table 2. The percentage share of the time dedicated by the average student to a certain singular activity during the early weeks before deadline is reported. The next premises are considered:

The weekly distribution of the time dedicated to a singular activity depends on the number of weeks that separates the deadline of this activity with the previous deadline in the same course.

The impact of a low intensity activity to the workload distribution won't be extended beyond five weeks before its date or deadline.

The student workload increases progressively as the date or deadline of the activity approaches. Nonetheless, grey cells indicate the cases where this progression is interrupted, which may indicate interference with activities of other courses, probably due to a

Week:
Student name:
Titling
Course:

Note: Take into account only the NON-PRESENTIAL hours you have dedicated to each activity and the tutorials.
NON-PRESENTIAL hours are those in which the teacher is not present

		Week	Week	Week	Week	Week	Week	Week	Week	Week	Week	Week	Week	Week	Week	Week	Week	Exam period	Others
H: number of full hours		17-feb	24-feb	03-mar	10-mar	17-mar	24-mar	31-mar	07-abr	14-abr	21-abr	28-abr	05-may	12-may	19-may	26-may	02-jun	09-jun	
M: additional minutes		23-feb	02-mar	09-mar	16-mar	23-mar	30-mar	06-abr	13-abr	20-abr	27-abr	04-may	11-may	18-may	25-may	01-jun	08-jun	13-jul	
Fecha de toma de datos		25-feb	04-mar	11-mar	18-mar	25-mar	01-abr	08-abr	13-abr	20-abr	29-abr	06-may	13-may	20-may	27-may	03-jun	08-jun		
Study of theory	H:																		
	M:																		
Study of exercises / problems	H:																		
	M:																		
Non-classroom work of classroom practices	H:																		
	M:																		
Making classroom practice reports	H:																		
	M:																		
Non-contact work with laboratory practices	H:																		
	M:																		
Making laboratory practice reports	H:																		
	M:																		
Tutorials	H:																		
	M:																		
Exam preparation	H:																		
	M:																		

Fig. 2: *Questionnaire for the weekly survey on student's workload*

ACTIVITY	Half week 1	Half week 2	Half week 3	Half week 4	Half week 16	Exam period	Total averages per activity
Study of theory	0,20	0,55	0,63	0,39	0,50	2,00	9,99
Study of exercises / problems	0,09	0,41	0,39	0,77	0,50	3,00	10,04
Non-classroom work of classroom practices	0,00	0,62	0,76	0,65	0,00	0,00	6,74
Making classroom practice reports	0,00	0,11	0,07	0,06	0,00	0,00	0,80
Non-contact work with laboratory practices	0,02	0,36	0,44	0,09	0,00	0,00	6,17
Making laboratory practice reports	0,00	0,16	0,05	0,16	0,00	0,00	2,10
Tutorials	0,00	0,00	0,00	0,00	0,00	0,50	0,50
Exam preparation	0,00	0,00	0,00	0,00	0,00	2,00	2,92
AVERAGE HOURS PER WEEK	0,31	2,20	2,34	2,11	1,00	7,50	39,27

Fig. 3: *Weekly hours employed, in average, to each kind of activity*

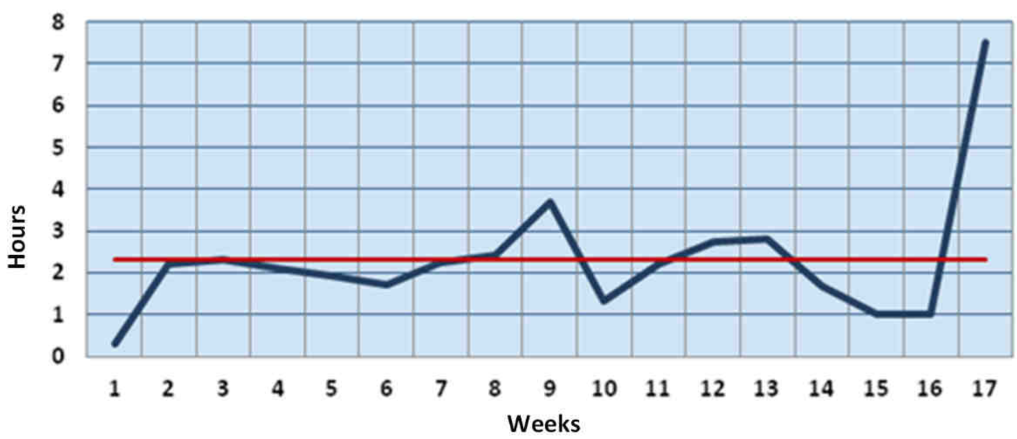

Fig. 4: *Weekly distribution of the workload in one of the courses under study*

Table 1: *Courses and activities analyzed*

Course	Low intensity activities	Medium intensity activities	High intensity activities	Very high intensity activities
TCM	L1	M1	H1	
			H2	
GA		M1		VH1
EVPI	L1	M1	H1	
			H2	
DI	L1	M1		VH1
		M2		

Table 2: *Low intensity activities: initial percentages, interpolated and normalized results*

Course/Activity		Percentage share dedication per week					
		1	2	3	4	5	Total
TCM/L1		6,30	6,38	15,06	22,22	50,04	100
EVPI/L1		8,85	15,73	75,42			100
DI/L1	Initial data	13,48	20,22	13,48	6,74	46,08	100
	Interpolation	13,48	20,22	28,84	37,46	46,08	146,08
	Normalization	9,23	13,84	19,74	25,64	31,55	100

Table 3: *TCM / L1 and DI / L1 average percentages*

Course / Activity	Percentage share dedication per week					
	1	2	3	4	5	Total
Average TCM/L1 and DI/L1	7,76	10,11	17,40	23,93	40,79	100

Table 4: *Low intensity activities: percentage share of dedication as a function of the available weeks*

Weeks of preparation	Percentage share dedication per week					
	1	2	3	4	5	Total
1	100					100
2	11,63	92,73				104,3
	11,14	88,86				100
3	8,85	15,73	75,42			100
4	9,39	13,13	19,83	58,11		100,4
	9,35	13,07	19,14	57,84		100
5	7,76	10,11	17,40	23,93	40,79	100

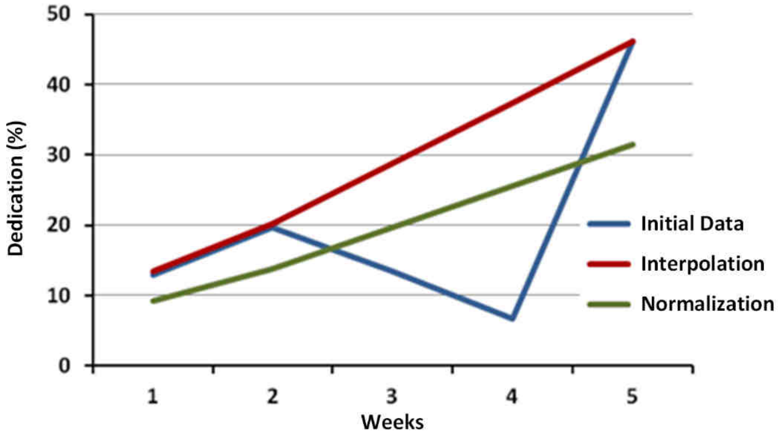

Fig. 5: *Results of interpolation and normalization: course DI, activity L1*

Table 5: *Medium intensity activities: percentage share of dedication as a function of the available weeks*

Weeks of preparation	Percentage share of weekly dedication									
	1	2	3	4	5	6	7	8	9	10
1	100									
2	36,70	63,30								
3	30,35	29,35	40,30							
4	19,40	24,43	24,97	31,20						
5	12,17	18,75	20,89	23,02	25,16					
6	9,46	8,80	14,23	18,42	21,92	27,17				
7	6,24	7,49	7,84	12,88	17,43	21,15	26,97			
8	3,23	5,71	6,91	7,51	12,39	16,97	20,70	26,59		
9	0,30	3,80	5,32	6,50	7,36	12,20	16,92	20,75	26,85	
10	0,37	3,92	4,19	5,09	6,04	6,99	11,44	16,05	20,66	25,27

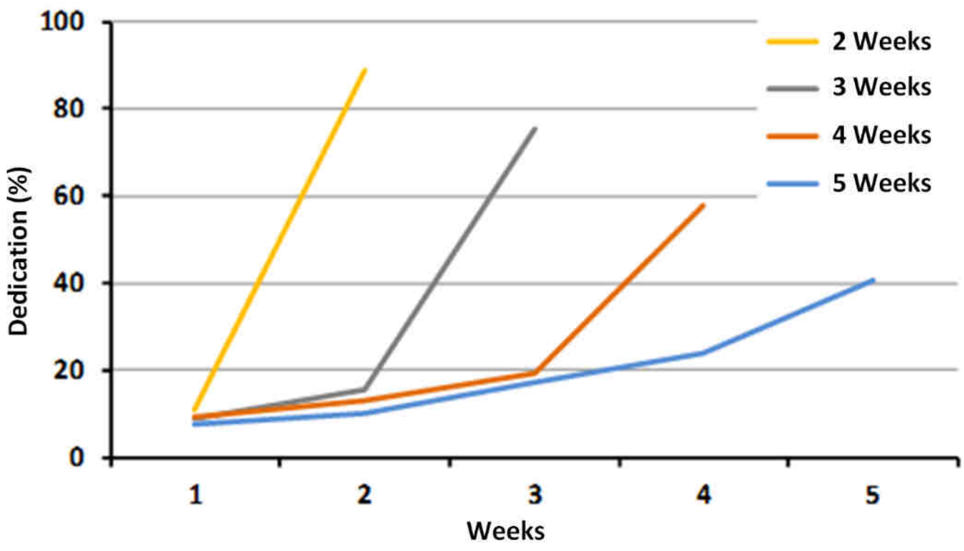

Fig. 6. *Low intensity activities: workload progression as a function of the available weeks*

Table 6. *High intensity activities: percentage share of dedication as a function of the available weeks*

Weeks of preparation	Percentage share of weekly dedication									
	1	2	3	4	5	6	7	8	9	10
1	100									
2	38,45	61,55								
3	15,04	36,81	48,15							
4	13,10	20,88	31,61	34,41						
5	9,41	11,81	14,21	25,03	39,55					
6	7,57	9,40	11,33	13,26	21,74	36,70				
7	6,17	8,98	10,41	11,14	11,86	14,23	32,15			
8	4,49	7,39	9,17	10,50	10,96	11,41	12,40	30,75		
9	2,95	2,79	8,59	9,66	10,97	11,23	11,49	11,48	30,84	
10	1,30	2,25	3,34	8,14	9,44	10,74	11,07	11,39	11,72	30,61

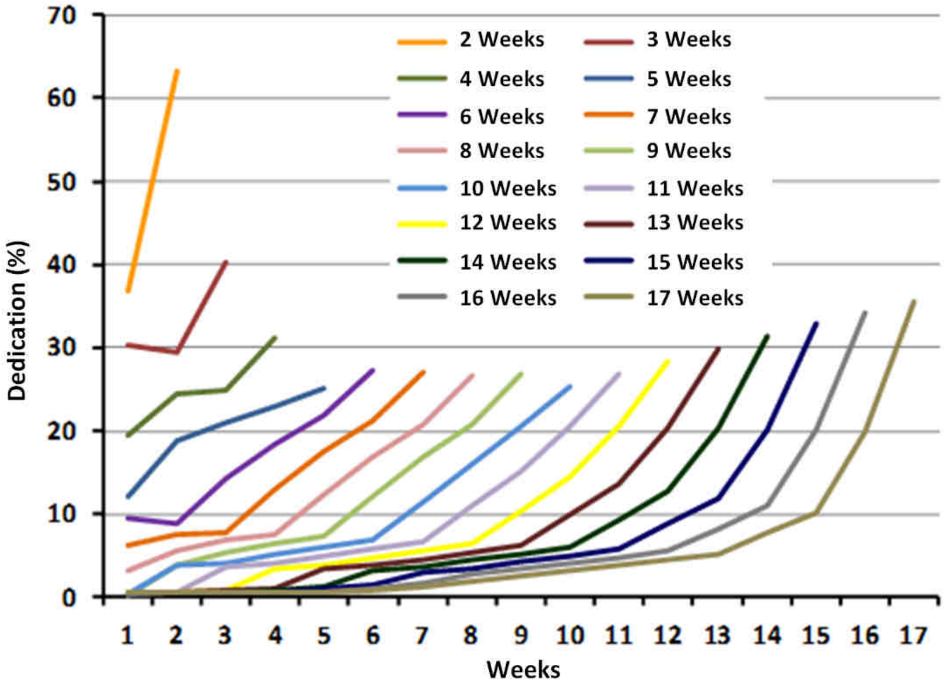

Fig. 7. *Medium intensity activities: workload progression as a function of the available weeks*

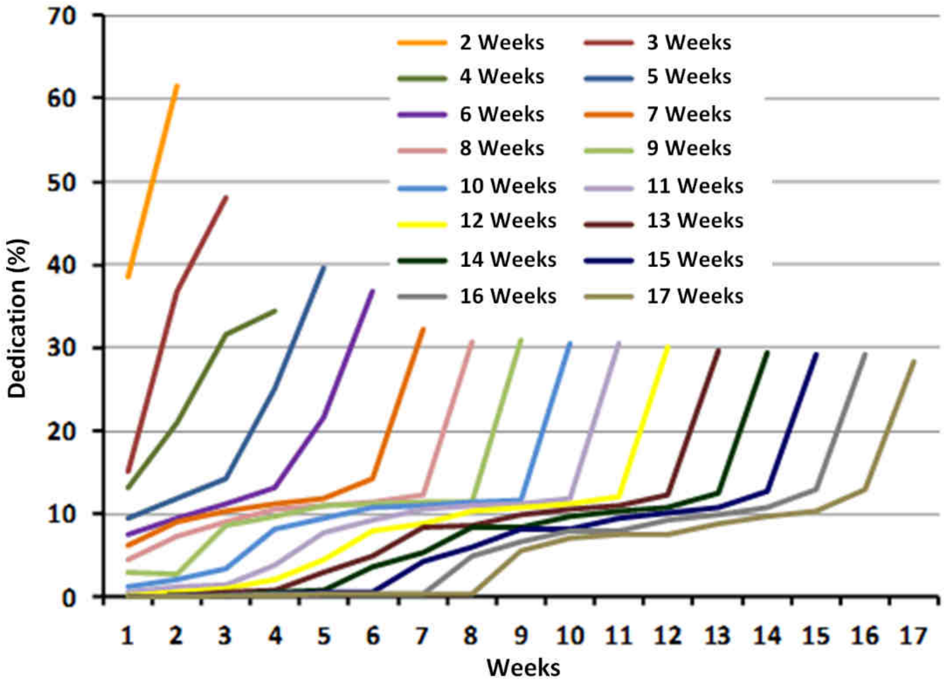

Fig. 8. *High intensity activities: workload progression as a function of the available weeks*

Table 7. *Very high intensity activities: percentage share of weekly dedication*

Percentage share of weekly dedication																
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
0,70	1,97	1,79	2,00	2,06	2,19	2,68	2,22	2,92	3,18	3,63	3,68	4,88	6,70	9,31	17,72	32,39

Table 8. *Percentage share of dedication to each type of activity*

Course	Low intensity activities (%)		Medium intensity activities (%)		High intensity activities (%)		Very high intensity activities (%)		Other activities (%)	
TCM	L1	8,20	M1	23,50	H1 H2	51,22			O1	17,08
GA			M1	30,80			VH1	59,78	O1	9,42
EVPI	L1	8,79	M1	20,13	H1 H2	71,08				
DI	L1	5,32	M1 M2	32,23			VH1	56,03	O1	6,42

Table 9. *Relations between share percentages of weekly dedication, mean values, deviations and selected relations*

	Very high (VH)			High (H)			Medium (M)		Low (L)
	VH/M	VH/L	VH/O	H/M	H/L	H/O	M/L	M/O	L/O
TCM				1,09	3,12	1,50	2,87	0,11	0,48
GA	1,94		6,35						
EVPI				1,77	4,04		2,29		
DI	0,87	10,53	8,73				3,03	0,13	0,83
Mean	1,41	10,53	7,54	1,43	3,58	1,50	2,73	0,13	0,65
Dev.	0,54	0	1,19	0,34	0,46	1,50	0,30	0	0,17
	VA = 1,41 * M			H = 1,43 * M			M = 2,73 * L		L = 0,65* O

failed horizontal coordination. In these cases, a linear interpolation of the workload progression has been included in order to estimate what workload would have resulted without that interference. The results are next normalized so as to fit 100 % in the sum of percentage shares. A graphical representation of this procedure for activity DI/L1 is shown in figure 5. Green cells show the final results.

There are two activities (TCM/L1 and DI/L1) that allow the students to take a total number of 5 weeks for their completion or preparation. The average of their weekly workloads are considered and shown in Table 3.

In order to retrieve workload data for those cases where no information is provided (activities with 2 and 4 weeks for completion or preparation) a linear interpolation and normalization has been accomplished using the available survey data. Next expressions are used:

For j = 2 weeks:

$$Cj_i = C(j+1)_{i+1} + \frac{C5_{i+1} - C(j-1)_{i-1}}{5-3} * (5-j)$$

For j = 4 weeks:

if i > 1

$$Cj_i = C(j-1)_{i-1} + \frac{C5_{i+3} - C3_{i+1}}{5-(j-1)} * (5-(j-1))$$

if i = 1

$$Cj_i = C3i + \frac{C3_i - C5_i}{2}$$

where C_{ji} is the percentage share dedication in week i for a low intensity activity with a completion period of j weeks. Table 4 shows the final results obtained (see green cells). Figure 6 represents the workload progression as a function of the number of weeks available for completion of the activity.

This algorithm has been extended for medium intensity activities. In this example, 5 activities are considered with a total time for completion of 2, 5, 9, 10 and 17 weeks respectively. The last case corresponds to an activity that is accomplished along the whole semester, including some time during the final examinations period. Like in the low intensity activities, the progressive growth of the workload is checked and, when needed, interpolated and normalized.

The results are used for estimation by linear interpolation of those cases where no information is provided, namely 3, 4, 6, 7, 8, 11, 12, 13, 14, 15 and 16 weeks available. The mathematical expressions employed to this aim are:

For 2 < j < 5 weeks:

if i > 1

$$Cj_i = C(j-1)_{i-1} + \frac{C5_{5-(j-i)} - C(j-1)_{i-1}}{5-(j-1)} * (5-j)$$

if i = 1

$$Cj_i = C5_i + \frac{C2_i - C5_i}{5-2} * (5-j)$$

For 5 < j < 9 weeks:

if i > 1

$$Cj_i = C(j-1)_{i-1} - \frac{C9_{9-(j-i)} - C(j-1)_{i-1}}{9-(j-1)}$$

if i = 1

$$Cj_i = C9_i + \frac{C5_i - C9_i}{9-5} * (9-j)$$

For 10 < j < 17 weeks:

if i > 1

$$Cj_i = C(j-1)_{i-1} + \frac{C17_{17-(j-i)} - C(j-1)_{i-1}}{17-(j-1)}$$

if i = 1

$$Cj_i = C10i + \frac{C17_i - C10_i}{17-10} * (17-j)$$

Table 5 presents the percentage share results for medium intensity activities with time for completion between 1 and 10 weeks. Figure 7 presents the workload progression as a function of the available weeks for completion of the activities.

Likewise, four high intensity activities were detected among the surveyed courses. These correspond to partial examinations with a lapse time since the deadline of the previous activity of 4, 5, 5 and 10 weeks respectively. The sequence of linear interpolation and normalization of results is applied also here. The results for the two activities with 5 weeks of preparation time are averaged.

Subsequent interpolation for estimation of the results unregistered is accomplished.

The next mathematical expressions have been employed for the high intensity activities:

For 1 < j < 4 weeks:

$$Cj_i = C4_{i+1} - \frac{C5_{5-(j-i)} - C4_{4-(j-i)}}{5-j} * (5-j)$$

For 5 < j < 10 weeks:

if i > 1

$$Cj_i = C(j-1)_{i-1} + \frac{C10_{10-(j-i)} - C(j-1)_{i-1}}{10-(j-1)} * (10-j)$$

if i = 1

$$Cj_i = C10i + \frac{C5_i - C10_i}{10-5} * (10-j)$$

For 10 < j < 17 weeks:

if i > 1

$$Cj_i = C(j-1)_{i-1} - \frac{C(j-2)_{(i-2)} - C(j-1)_{i-1}}{(j-1)-(j-2)}$$

if i = 1

$$Cj_i = \frac{Cj_{(i+1)}}{2}$$

Table 6 shows the results for the high intensity activities with up to 10 available weeks for preparation. The progression of the workload is depicted in figure 8, as a function of the total number of available weeks.

Two activities with very high intensity are recorded, whose preparation extends over the whole semester. Like in the previous cases, the estimation of results is obtained through interpolation, normalization and averaging of results. Given that these activities correspond to final exams, which are only planned in the reserved period starting from week 17, no additional interpolation is needed. The results are shown in Table 7.

The methodology and process described above has allowed to estimate the weekly distribution of the students workload, for each activity, as a function of the number of weeks available for its preparation. In order to retrieve the total number of hours that the average student would spend with each activity, the percentage share of their time dedication for the four courses selected is shown in Table 8.

Table 9 shows the relations between the percentage shares of weekly dedication to each activity, as reported in Table 8. This analysis takes into account the number of activities of each family that have been planned. The average values for each activity, for each course, have been calculated. The last row of the table includes, among all the relations, the one with lower deviation with respect to the mean values. Results with only one sample are likewise discarded.

Importantly, the total number of hours in a course must be equal to the workload indicated in the corresponding Teaching Guide, namely:

H = VH·NVH + H·NH + M·NM + BL·NL + O

where NVH is the number of very high intensity activities planned in a given course, NH is the number of high intensity activities, etc.

Taking into account that there will be at least one very high intensity activity per course (the final exam), substitution of values yields:

$$VH = \frac{H}{N_{VH} + 1{,}0155 \cdot N_H + 0{,}7117 \cdot N_M + 0{,}2608 \cdot N_L + 0{,}3988}$$

with H = 1,0155 * MA; M = 0,7117 * MA; L = 0,2608 * MA and O = 0,3988 MA.

Finally, the results of the survey to students on perceived workload of the courses taught during a semester [11] have been incorporated to the analysis.

This survey quantifies each course workload in a Likert-type 1-5 scale. The total number of hours of a single course (Hi) have been corrected according to:

$$H_f = H_i \times \frac{CE_i}{MCE}$$

where CEi accounts for the workload of a course as perceived by the students, and MCE is the mean perceived workload of all the courses taught during the semester.

3. DICUSSIONS OF RESULTS

All the expressions and weekly workload distributions for each type of activity have been programmed in Visual Basic and implemented in the spreadsheet that includes the joint chronogram. The graphical representation of the weekly workload distribution along the semester is also included, as shown in figure 9. The workload of single courses, as well as the overall workload are shown, easing the horizontal coordination of the semester through the direct reorganization of the activities.

The model described in this work has been successfully implemented during the academic year 2017-18 in the Engineering School with higher number of students at Universidad Politécnica de Cartagena. The tool allows to simulate the student's workload distribution as a function of the number, type and timeline of the singular activities planned during each semester. If the date or deadline of an activity is changed in the chronogram, the workload distribution is automatically recalculated and represented in a graph. This is highly powerful for easing the horizontal coordination procedures: the activities can be programmed in the chronogram ensuring a smooth distribution, free of peak loads.

In order to use this application, the faculty must have previously elaborated an initial programming of their courses, including expected dates or deadlines. This is the information introduced in the model, and it serves as first step to set up changes conducive to obtain an acceptable workload distribution.

4. CONCLUSIONS

Table 8 shows the percentage shares of workload that, in each course, have been assigned to their activities. The dedication increases for intensities of activities between low and high. However, high intensity activities (partial examinations) show workload values which are slightly higher than those of very high intensity activities (e.g. final evaluation tests). This is due to the fact that high intensity activities typically outnumber very high intensity ones by a factor of at least 2, and it is reasonable that the total number of hours might surpass those employed for the preparation of the final exam. On the other hand, partial examinations might be eliminating-type; the students that pass partial examinations might not have to attend the final exam and, consequently, the workload assigned to the final exam is only accomplished by some students.

The workload of a given activity may vary significantly from one student to another. Owing to this, the credits ECTS and the workload linked to these are referred to the "average student", and they represent the work necessary by this student to obtain the learning outcomes. The results employed in this study derive from the weekly survey and have been obtained, both with respect to the total number of hours and to the timeline, by averaging the values provided by the students.

The method of calculation of the workload distribution linked to each type of activities involves a certain complexity but it retrieves reliable information, as it has been obtained from results of the same survey and it represents the real workload that the students employ, as an average, to finish their activity. However, the consultation of the information about workload in the Teaching Guide is still open.

The main contribution of this model is that it helps interpret how the workload associated to an activity is to be distributed along the time depending on how are planned the other activities in the timeline. This time-dependent distribution makes the model more complex but also more useful, as it retrieves the distribution of the workload along the semester, for a given course and for all of them. This kind of information is not available in the Teaching Guides or, at least, it is not realistic as it does not take into account the interactions between activities.

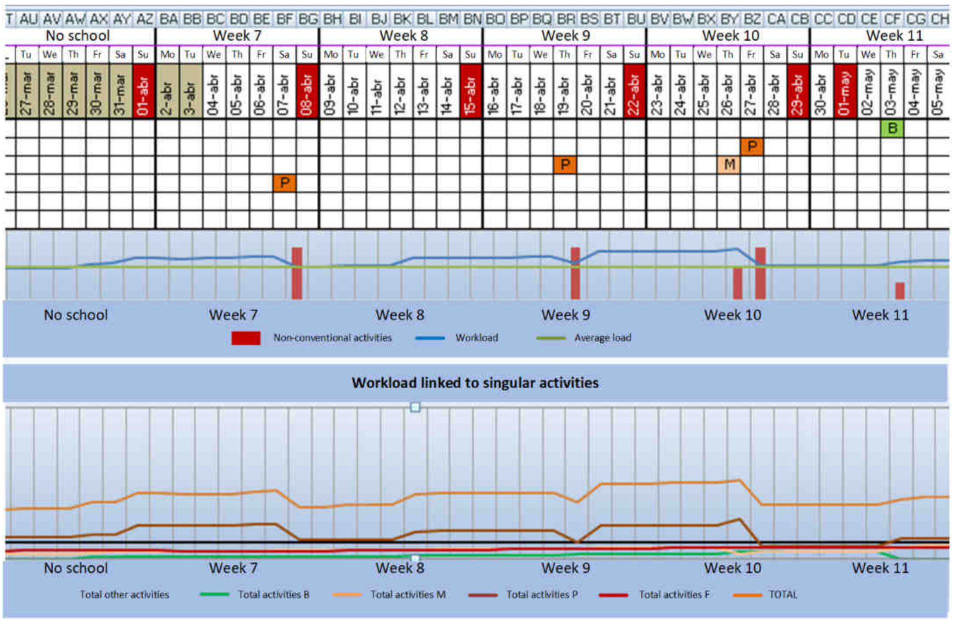

Figure 9. *Joint chronogram and graphical distribution of estimated workload*

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REFERENCES

[1] E. Chambers, Work-load and the quality of student learning, Studies in Higher Education 17 (2) (1992) 141-153, doi:10.1080/03075079212331382627.

[2] L. Giles, An investigation of the relationship between students perceptions of workload and their approaches to learning at a regional polytechnic. PhD diss., Massey +University, 2009.

[3] D. Kember and D.Y.P. Leung, Development of a questionnaire for assessing student´s perceptions of the teaching and learning environment and its use in quality assurance, Learning Environments Research 12

(1) (2009) 15-29. doi: 10.1007/s10984-008-9050-7.

[4] J. Biggs, and C. Tang, Teaching for Quality Learning at University, What the Student Does, 4th ed. New York: McGraw-Hill, 2011.

[5] G. Scully, y R. Kerr, Student workload and assessment: Strategies to manage expectations and inform curriculum development, Accounting Education 23 (5) 443-466, 2014.

[6] A. Fielding, Student assessment workloads: a review, Learning and Teaching in Action (LTiA) 7 (3) 7-15, 2008.

[7] A. Pitt, F. Oprescu, G. Tapia, G. and M. Gray, An exploratory study of students' weekly stress levels and sources of stress during the semester, Active Learning in Higher Education 19 (1) (2008) 61-75. doi: 10.1177/1469787417731194.

[8] K. Dixon, S. Shelleyann and R. Dixon, University students' perception of workload: The challenges and vagaries of assessment." AARE Conference. AARE Inc (2007).

[9] A. García Martín, M.M. Andreu, A.J. Briones, S. Busquier, J. Conesa, M.S. García Cascales, J. García León, M.A. García del Toro et al. Coordinación docente horizontal y vertical [Vertical and horizontal academic coordination]. Cartagena: CRAI UPCT ediciones (2015).

[10] D. Kember, Interpreting student workload and the factors which shape students' perceptions of their workload, Studies in Higher Education 29 (2) (2004) 165-184. doi: 10.1080/0307507042000190778.

[11] A. García Martín, and J. García-León, Una experiencia de medición de la carga de trabajo percibida por los estudiantes para facilitar la coordinación horizontal, REDU. Revista de Docencia Universitaria 15 (1) (2017) 81-104.