ESTIMATING THE WORKLOAD OF A STUDENT ADAPTED TO THE EHEA IN THE “CONSTRUCTION OF NON-STRUCTURAL ELEMENTS” TECHNICAL ARCHITECTURE SUBJECT

R.T. Mora García, M.F. Céspedes López, L. Rodríguez Valenzuela, A. Jiménez Delgado

University of Alicante (SPAIN)

rtmg@ua.es, paqui.cespedes@ua.es, leoncio.rodriguez@ua.es, antonio.jimenez@ua.es

Abstract

The new ECTS credit accumulation and transfer scheme, established for adaptation to the European Higher Education Area, entails changing from the old approach to a more student-centred learning approach, measuring the time students spend on study and encouraging independent learning and more active participation. Consequently, student workload includes the hours corresponding to attendance at lectures (theoretical and/or practical sessions), study, seminars, assignments, work experience or projects, and those required for the preparation and sitting of examinations and assessment tests. The aim of this research is to estimate the workload of a student in the third-year “Construction of non-structural elements” subject on the current Technical Architecture degree course (currently being phased out) and adapt it to the demands of the Building Engineering degree course. The descriptive and experimental methodology uses a survey-type tool to gather the data sought. The results obtained indicate the need for the length of course activities to be reconsidered so as to reduce student workload and adjust the time spent on activities to the established limits. The need is also detected to correct low class attendance so as to improve both teaching quality and academic results.

Keywords: ECTS experiences, working load, moodle, Technical Architecture, building details.

1 INTRODUCTION

The course leading to the degree of Technical Architecture is currently being converted to the degree in Building Engineering. At present, this degree is taught at 34 Spanish universities [1], either through conversion courses for graduates or courses for newly enrolled students.

Converting the Technical Architecture degree to the Building Engineering degree entails important changes, as the new scheme will establish a system of academic degrees which are easily recognised and comparable with those of the rest of Europe. It will also enable student, teacher and researcher mobility and will ensure high quality education.

In December 2007, the specific regulations governing the degree in Building Engineering were published in Resolution of the 17th December 2007 [2] and Order ECI/33855/2007 of the 27th of December [3]. The degree in Building Engineering is spread over four academic years, each of which is worth 60 ECTS (European Credit Transfer System) credits, giving a total of 240 ECTS [4].

This new ECTS credit accumulation and transfer scheme was created with the goal of establishing a standard system for credits which would be transferable throughout Europe. The current approach has a stronger focus on student-centred learning, measuring the time students spend on study and encouraging independent learning and more active participation.

In accordance with art. 3 of Royal Decree (RD) 1125/2003, the European credit *“is a unit of measure of academic achievement which represents the amount of student work required to satisfy the objectives of the course programme, and which is obtained through satisfactorily completing each of the subjects which form part of the course programmes in various disciplines leading to an official university qualification recognised throughout the national territory”.*

The ECTS credit scheme provides a measure of the work that students must carry out to acquire the knowledge, abilities and skills necessary to successfully complete the different subjects included in the corresponding degree course programme [5].

Consequently, student workload includes the hours corresponding to attendance at lectures (theoretical and/or practical sessions), study, seminars, assignments, work experience or projects, and

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those required for the preparation and sitting of examinations and assessment tests. One ECTS credit is equivalent to a minimum of 25 and a maximum of 30 hours of student work.

In accordance with University of Alicante regulations, each ECTS represents 10 hours of classroom teaching in any form, and between 15 and 20 hours of other student work, including assessment.

1.1 Technical Architecture and Building Engineering at the University of Alicante

The University of Alicante (UA) began to implement the first year of the Degree in Building Engineering (BE) [6] in the academic year 2010-11, and subsequent years will be incorporated progressively until the degree in Technical Architecture is completely phased out in 2012 -13. Consequently, both degrees are currently being taught simultaneously as part of a transitional phase until adaptation is completed.

At present, the third year of the degree in Technical Architecture (TA) [7] is being taught for the last time. The incorporation of TA course subjects into the present degree in BE has implied significant changes in the methodologies employed, in order to adapt to the European Higher Education Area (EHEA).

In the academic year 2010-11, a virtual learning platform was launched to host e-learning systems for the subject "Building non-structural elements" (BNSE), which is taught in the third year of TA at the UA. To achieve this we used the Moodle platform (Modular Object-Oriented Dynamic Learning Environment) in order to take a quantitative and qualitative leap forward in terms of distance learning activities.

BNSE is a core subject, lasting a full academic year and entailing a workload of 12 LRU credits, that forms part of a course programme which is being phased out. Classroom-based teaching includes 60 hours of theory and 60 hours of practical sessions, taught in two 2-hour long classes per week. There are 6 groups of students divided equally into morning and afternoon groups, with different teachers for the morning and afternoon sessions. The subject is split into five thematic blocks, two of which are taught in the first semester and three in the second.

These future subjects on the Degree in Building Engineering will be called Building Non-Structural Elements I (code number 16024) and II (code number 16043). Both will be six months long, will be worth 6 ECTS credits, and will be taught in the 3rd year (5th and 6th semesters).

1.2 Statement of the Problem

Since the subject programme contains, among other things, an estimate of the student workload, it was necessary to verify whether or not this estimate corresponded to reality, or rather to students' perception of the time and effort required.

It was considered essential for teaching staff to confirm that the estimated subject workload coincided with students' actual workload.

1.3 Objectives

The main objective was to determine the student workload corresponding to the subject currently being taught (part of the course programme being phased out), in order to adapt it to the demands of the future degree in Building Engineering.

A further objective was to determine whether differences existed between male and female students for the variables analysed.

1.4 Review of the literature

The aim was to continue the work previously carried out by teachers of the BNSE subject [8], entitled "Adaptation to ECTS of the 'Building non-structural elements' subject for the future degree in Building Engineering", to analyse the impact of changes in the subject due to its adaptation to the EHEA. Furthermore, it was also possible in this study to quantify the hours students spent on their learning task, from information collected through surveys.

Although not an exhaustive list, the studies conducted to date [9] [10] have taken a general approach, considering all the subjects forming part of the degree in TA and describing the skills and requirements necessary for adaptation to the EHEA. Other studies have specifically focused on the adaptation of the first year of TA to the EHEA [11].

This present study focused on one of the range of subjects taught in the Building and Planning Department in the degree of TA, specifically, a subject in the field of "building". Of particular note among the studies conducted on this subject is the report by Gómez Soberón *et al.* [12] for the Polytechnic University of Catalonia on the adaptation of building subjects taught at the Department of Architectural Constructions to the new concept of European higher education credits.

1.5 Description of the subject

The subject is theoretical and practical, and is taught through lectures, practical workshops in the classroom, supervised academic work and non-classroom-based activities. The subject content is divided into 5 different blocks (roofs, walls, partitions, floors and point of contact with the ground), which are further broken down into subsections.

Supervised academic work consists of compiling files on construction details, in order for students to gain an understanding of the reality of a construction project, to develop a sense of observation, to acquire experience of the different roles within such a project and to encourage critical thinking.

Within this activity, the student must visit a building under construction, choose a construction detail according to the topic in question, produce a sketch and a scale drawing of the detail, and establish a critical opinion of it.

These individual and/or group tasks are carried out weekly and added to a work folder (portfolio) which the teacher will evaluate in a first partial assessment in February, with suggestions for improvements. A final mark is awarded for the completed work submitted in May.

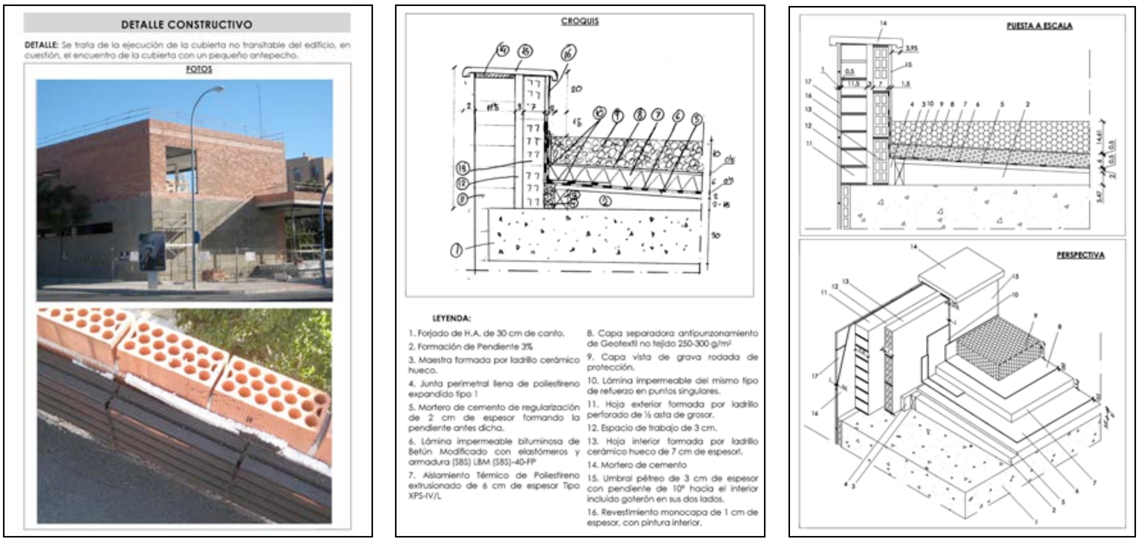

Fig. 1. Example of documents to be created for each construction detail.

2 METHODOLOGY

On the basis of the research problem posed, a descriptive and experimental methodology was chosen, using a survey as the tool for collecting data.

2.1 Description of the context and participants

The study population comprised students enrolled on the BNSE subject in the 3rd year of the TA degree course [13] at the UA during the academic year 2010-11. From a total of 297 students, only 182 were required to do the coursework. Since the study focused on these latter students, i.e. those who had not yet completed the academic work established for continuous assessment of the subject, the size of the study population was N=182.

The sampling method used was simple random sampling without replacement [14] [15], since allocation of all possible individuals in a population was equiprobable.

The sample size *n* for estimating the mean was 124 individuals, and the significance or risk level was established as α=5% for a 95% probability (confidence level *k*=1.96). Since the individuals were new to the subject, a worst case scenario was adopted with a sample selection probability of P=50% and an absolute error δ of 5% using the formula established by Santos *et al*. (2003, p.138) [14] and García (1999, p.142) [15].

2.2 Materials and methods

The Moodle platform was implemented for this subject and used to carry out the learning activities and distribute and collect the questionnaires used to gather research data.

Learning activities were based on the use of Assignment and Workshop Modules, in which it is possible to attach activity files in any digital format. The Workshop Module provides greater advantages for student learning, since the possibility of peer assessment encourages critical thinking and enables students to compare their work with that of others, increasing the quality of the final document (Mora Garcia *et al.*, 2011) [16].

For this trial, 22 activities were scheduled, of which 18 were conducted using the Assignment Module option and 4 were performed under the Workshop Module. These activities were spread over the 30 weeks comprising the academic year (excluding public holidays and examination periods).

These activities constituted the coursework portfolio contents and will be used to assess the subject.

The survey was conducted using the Moodle platform, and the statistical software package SPSS was used for data analysis.

2.3 Instrument

In order to determine student workload, among other aspects related to coursework, a survey was conducted in April and May 2011, to which 125 students responded.

The survey consisted of 19 items aimed at obtaining information relative to the sociodemographic variables of the study population, the number of credits for which students were enrolled, student attendance and class participation, attendance at tutorials, time spent on the subject and level of proficiency in use of computer tools.

Items with an ordinal scale response format were designed as Likert-type scales with five response options: never, almost never, sometimes, almost always and always.

Those questions relevant to the present paper are given below:

Table 1. List of questions.

QUESTIONS	Variable	Measure
A) GENERAL INFORMATION:		
1. Sex: Male / Female	*SEX*	Nominal
2. Age: (years)	*AGE*	Scale
3. Do you do any kind of paid work? *I do not work / Part-time 20h / Full-time 40h*	*WORK*	Ordinal
B) INFORMATION ON THE SUBJECT:		
6. Is this the first year you have studied the subject? *Yes / No*	*STUDENT*	Nominal
7. Do you attend classes regularly? *Never / Almost never / Sometimes / Almost always / Always*	*ATTENDANCE*	Ordinal
8. Do you participate actively in class? *Never / Almost never / Sometimes / Almost always / Always*	*PARTICIPATION*	Ordinal
9. Did you attend face to face tutorials throughout the course? *Never / Almost never / Sometimes / Almost always / Always*	*TUT_ATTEND*	Ordinal
10. Did you take part in virtual tutorials throughout the course? *Never / Almost never / Sometimes / Almost always / Always*	*TUT_VIRT*	Ordinal

11. How much time (in hours) do you spend during the week studying the subject (reading material related to the subject, completing exercises, finding information in books, etc.).	*H_STUDY*	Scale
C) INFORMATION ON COURSEWORK:		
13. How much time on average do you spend on each construction project file?		
a. Site visit (hours)	*H_VISIT*	Scale
b. Finding and studying information (hours)	*H_INFO*	Scale
c. Completing the file (hours)	*H_FILE*	Scale
14. How much time (hours) do you spend on a scale drawing of an on-site sketch:	*H_SCALE*	Scale
15. How much time (hours) do you spend on a 3D drawing of a scale drawing:	*H_3D*	Scale
16. Did you look for information to complete the details in the construction project file? *Never / Almost never / Sometimes / Almost always / Always*	*INFO*	Ordinal
D) COMMAND OF COMPUTER TOOLS		
18. Indicate your command of the following aspects: *Low / Medium-Low / Medium / Medium-High / High*		
a. Using text editors (Word, OpenOffice, or similar)	*A_EDITOR*	Ordinal
b. Creating a PDF from a document	*A_PDF*	Ordinal
c. Knowledge of how to scan documents (sketch)	*A_SCANNER*	Ordinal
d. 2D CAD Drawing Tools (Autocad, MicroStation, or similar)	*A_CAD2D*	Ordinal
e. Digital 3D drawing tools (Autocad, MicroStation, Sketchup, or similar)	*A_CAD3D*	Ordinal
f. Photo retouching tools (to improve the appearance of scanned drawings, photos, etc.)	*A_PHOTO*	Ordinal

Source: by the authors.

2.4 Reliability and validity

It would be outside the scope of the present study to attempt to validate the questionnaire here. However, in the pilot stage, the authors wished to determine whether there were any correlations between the variables and the existence of factors (dimensions) among the variables of the instrument. These results should be considered as initial rather than conclusive data on the reliability and validity of the instrument.

The variables analysed corresponded to blocks B, C and D of the questionnaire, which were used to collect general information about students in relation to the subject, hours spent on coursework and command of computer tools.

A factorial analysis was conducted with the seventeen variables indicated above, and a correlation matrix was obtained, the determinant of which (0.004) indicated that there were variables with high inter-correlations. The correlation coefficient matrix indicated that there were over 0.40 relationships (p= .000) and up to 0.78 (p= .000) for a set of variables which, as discussed below, can be grouped into several factors.

The Bartlett sphericity test confirmed the existence of correlation between variables (p= .000), and the Kaiser-Meyer-Olkin test (KMO=0.68) indicated an acceptable sampling adequacy in this analysis.

The anti-image correlation matrix obtained gave very low values, and few values close to zero, indicating acceptable goodness of fit or suitability of the factor analysis.

To determine which variables were grouped in each component (factor), it was necessary to analyse the component matrix, and this was performed using the Principal Components method with Varimax rotation. As can be observed, up to four factors could be established, as summarised in the following table:

Table 2. Rotated Component Matrix[a].

Variables		Component			
Description	**Abbreviation**	**1**	**2**	**3**	**4**
Class attendance	*ATTENDANCE*			.487	
Participation in class	*PARTICIPATION*			.575	
Attendance to face-to-face tutorials	*TUT_ATTEND*			.782	
Participation in virtual tutorials	*TUT_VIRT*			.775	
Weekly hours of study	*H_STUDY*		.618		
Hours to visit site	*H_VISIT*				.686
Hours finding information	*H_INFO*				.804
Hours completing file	*H_FILE*		.793		
Hours scale drawing	*H_SCALE*		.880		
Hours 3D drawing	*H_3D*		.898		
Finding information for file	*INFO*				.512
Using text editors	*A_EDITOR*	.677			
Creating a PDF file	*A_PDF*	.700			
Scan documents	*A_SCANNER*	.674			
2D CAD Tools	*A_CAD2D*	.730			
3D CAD tools	*A_CAD3D*	.663			
Photo retouching tools	*A_PHOTO*	.597			

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

The first component related to variables concerning the perception that students have of their ability to use certain tools, and thus it has been called "computer skills". The second component concerns the hours students spend on work, mostly at home, and so it has been called "Time spent on the subject". The third component includes variables related to student participation in classes and tutorials, and so it has been called "active participation". The fourth component includes variables related to preparation of the assignment, and has been called "Time for preparation".

The following table summarises the number of variables per component, the Total Variance Explained (55%) per component and Cronbach's Alpha by component and instrument. The values are low but acceptable in the absence of improvements to the instrument and further analysis.

Table 3. Results of analysis.

Component	Variables	% Variance Explained	Cronbach's Alpha
1	6	19	.753
2	4	17	.604
3	4	12	.614
4	3	7	.547
Total	**17**	**55**	**.603**

3 RESULTS

The results will be discussed from the dual perspective of the information provided by students and teachers.

3.1 Descriptive study

The study population consisted of 182 students, of whom 147 were enrolled for the first time, and were consequently required to complete the coursework, whilst the other 35 students had been enrolled previously but had not yet carried out the coursework.

The sample consisted of 125 students, of whom approximately two thirds were male and one third female, a proportion that corresponded approximately to the total number of students enrolled [13] on the three years of the TA degree course in the academic year 2010-11.

3.2 Statistics

The variable "Hours per week (h/wk)" was obtained applying the following formula, assuming that the work is done by two students:

$$TIME = \frac{30 \times H\_STUDY + 5 \times H\_VISIT + \frac{43}{2} \times (H\_INFO + H\_FILE) + \frac{10}{2} \times (H\_SCALE) + \frac{3}{2} \times (H\_3D)}{30}$$

The assumption was based on a 30 week academic year, 5 site visits during the year, and group work consisting of 43 files, 10 scale drawings and 3 perspectives.

The information that emerged from the descriptive statistics of the six variables analysed showed that maximum values were far from the mean (see Table 4 for all variables and Fig. 2 for "Hours per week"). Given that the maximum workload of 25-30 hours was estimated as a mean value, and since the diversity of the population could be very high, it was necessary to obtain the confidence interval for the mean for the variable "Hours per week" with a confidence level of 95%. It was established that the average student's commitment to the tasks related to study and coursework was 10±1 hours/week.

Table 4. Descriptive statistics.

	TIME	*H_STUDY*	*H_VISIT*	*H_INFO*	*H_FILE*	*H_SCALE*	*H_3D*
Mean	10,07	7,13	1,71	1,38	1,88	1,26	2,11
Std. Error of Mean	0,53	0,45	0,11	0,08	0,12	0,09	0,18
Median	8,1	5	1	1	2	1	2
Mode	7,9	5	1	1	1	1	2
Std. Deviation	5,97	5,05	1,18	0,95	1,31	1,01	2,05
Variance	35,64	25,53	1,39	0,90	1,72	1,03	4,21
Range	27,9	24	8	5	10	8	19
Minimum	2,6	1	0	0	0	0	0
Maximum	30,5	25	8	5	10	8	19
Sum	1259	891,5	214,1	172,5	234,9	157,7	263,6
Valid N	125	125	125	125	125	125	125

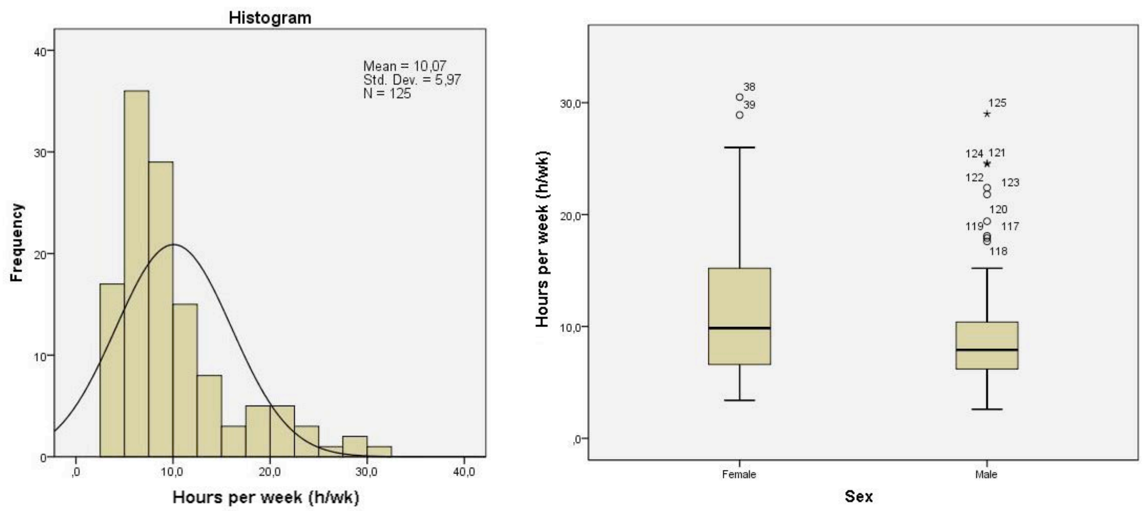

Fig. 2. Frequency histogram and box plot of the var. "Hours per week".

Table 5. Descriptive for the variable "Hours per week" by sex.

Sex		Statistics (h/week)	Intervals
Female	Mean	11.84	±2.27
	5% trimmed mean	11.32	
Male	Mean	9.24	±1.12
	5% trimmed mean	8.71	
Total	**Mean**	**10.07**	**±1.06**

If the variable "Hours per week" is analysed from the perspective of sex (see Table **5** and Fig. 2), it can be seen that females reported spending approximately 2.6 hours more on the subject than males. We determined whether there were any differences in "Hours per week" by sex using the Mann-Whitney U test, and the H_0 could not be rejected. Consequently, it must be accepted that hours spent per week is the same for women as for men.

Using the same Mann-Whitney U test, we determined whether any differences existed between males and females for the other variables. The statistically significant differences are shown below:

Table 6. Statistically significant variables.

Description	Abbreviation	Mann-Whitney U
Weekly hours of study	*H_STUDY*	*U*=1295; *p*=.031; *r*=0.19
Finding information for file	*INFO*	*U*=1277; *p*=.017; *r*=0.21
3D CAD tools	*A_CAD3D*	*U*=1336; *p*=.047; *r*=0.18

As can be seen in Fig. 3, "weekly hours of study" were not the same for males and females: for males there is a strong peak in the middle zone, whilst the mean for females is higher than for males, distributed along the horizontal axis without any notable concentration of values.

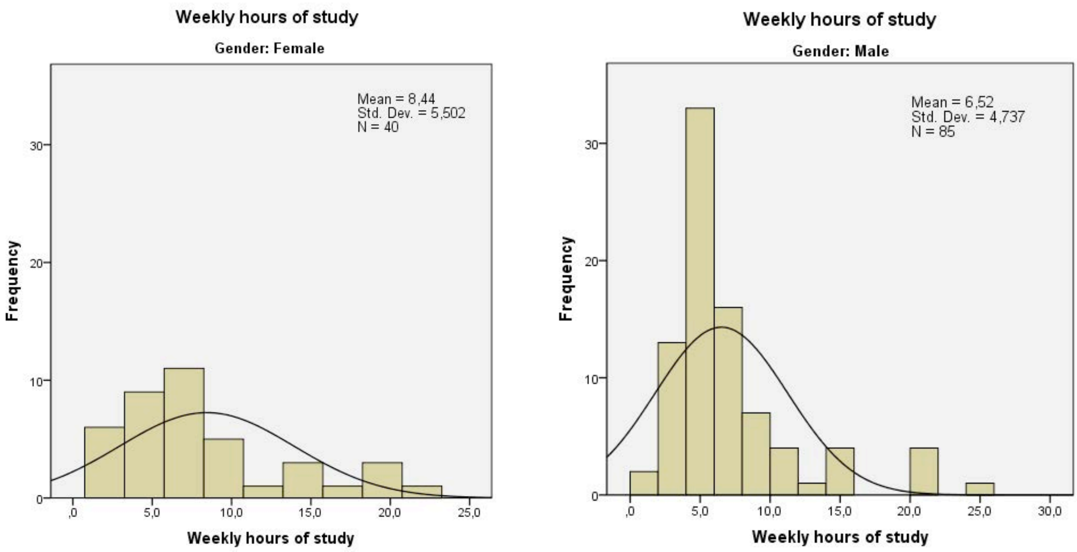

Fig. 3. Frequency histogram of the variable "Weekly hours of study" by sex.

As for the variable "Finding information for file", the high percentage of females who always or almost always (83%) sought information was notable, compared with the males who reported seeking information sometimes or almost always (64%).

In general, the perception of skills in 3D drawing tools was higher for males than for females, with a level above the measurement scale.

Table 7. Crosstabulation.

Sex	Finding information for file					Total
	Never	Almost never	Sometimes	Almost always	Always	
Female	0 (0%)	2 (5%)	5 (12%)	10 (25%)	23 (58%)	40 (100%)
Male	2 (2%)	2 (2%)	19 (23%)	35 (41%)	27 (32%)	85 (100%)
Total	2 (2%)	4 (3%)	24 (19%)	45 (36%)	50 (40%)	125 (100%)

Sex	3D CAD tools					Total
	Never	Almost never	Sometimes	Almost always	Always	
Female	10 (25%)	17 (42%)	6 (15%)	3 (8%)	4 (10%)	40 (100%)
Male	13 (15%)	23 (27%)	30 (35%)	14 (17%)	5 (6%)	85 (100%)
Total	23 (18%)	40 (32%)	36 (29%)	17 (14%)	9 (7%)	125 (100%)

3.3 Class attendance

Data was collected on classroom attendance for the three groups attending morning classes, comprising 151 students in total. Of the actual 27 weeks in which classes were taught, attendance was analysed for 21 weeks (78%). It can be observed that the average number of students who attended was 82 students per session (55%), and that at no time was 68% attendance exceeded.

Question no. 7 of the questionnaire was related to students' perception of whether they attended class. 70% of students reported always attending and 26% almost always, reflecting a huge difference with reality.

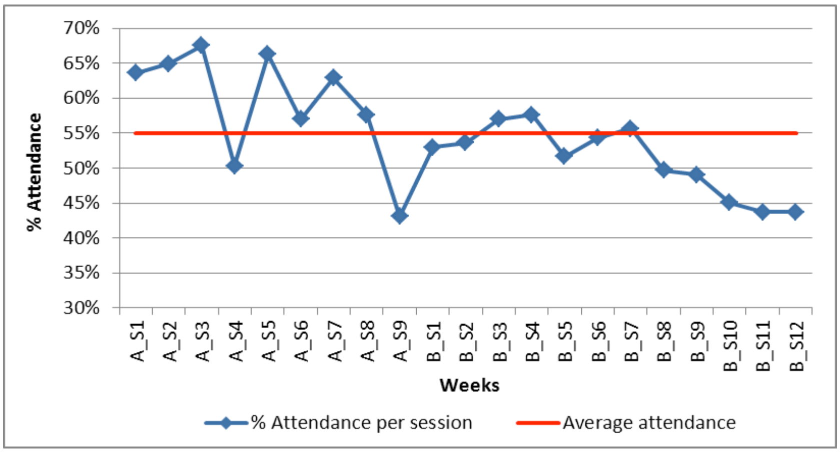

Fig. 4. Percentage of class attendance for morning session students.

3.4 Calculation of the workload

The BNSE subject is worth 12 credits of theoretical and practical work, which corresponds to an annual student commitment of 300-360 hours spread over 120 hours of class attendance and 180-240 hours of independent study. Based on student perception, the estimated workload is 420±30 h. This indicates that it will be necessary to rethink the volume of workload to reduce the number of construction project files and thus bring time spent by students into line with the established limits.

Table 8. Workload.

Activity	Initial estimate	Calculated	Partial	Total
Class attendance	120 h	4 h x 30 weeks	= 120 h	420±30 h
Independent study	180-240 h	10±1 h x 30 weeks	= 300±30 h	

4 CONCLUSIONS

On the basis of the results obtained, we consider that it is necessary to rethink the volume of coursework and reduce the workload in order to bring the time spent by students into line with the established limits.

Although class attendance is a necessary factor for students to acquire knowledge, abilities and skills, students fail to comply with this requirement. Since this variable forms part of the student workload, mechanisms should be established to regulate this situation in order to improve the quality of teaching and academic outcomes.

A need has thus been identified for the University to implement the measures necessary to coordinate the workload for subjects taught in the same academic year in order to distribute student effort effectively throughout the course.

In previous years, it was observed that the vast majority of students did not spread their academic workload throughout the course but rather concentrated all their efforts in the final weeks before the deadline for handing in work. This virtual method of handing in and monitoring activities facilitates management of the entire assessment process. However, it was observed that as the course drew to a close, failure to hand in coursework increased, probably caused by simultaneous demands for work in different subjects, leading to an excessive workload.

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