VIRTUAL LEARNING ENVIRONMENT IN THE "CONSTRUCTION OF NON-STRUCTURAL ELEMENTS" TECHNICAL ARCHITECTURE SUBJECT

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Abstract

By creating a virtual learning environment for the "Construction of non-structural elements" Technical Architecture subject, various activities were adapted to the European Higher Education Area with the aim of promoting practices that would help students develop their skills and abilities through both group and individual work. The main aim was to determine which learning tools help to improve teaching quality and help how teaching work is managed. The process of implementing the platform and the degree of its success are described through teachers' experiences and by the data gathered from surveys administered to the students involved. The results obtained indicate that the needs of the subject are best suited to workshop activities, as they foster students' critical sense and increase the quality of the final document produced.

Keywords: Moodle, task, workshop, Technical Architecture, building details.

1 INTRODUCTION

The incorporation of Technical Architecture (TA) subjects [1] into the current Degree in Building Engineering [2] at the University of Alicante (UA) implies significant changes in the methodologies employed in order to adapt them 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. In order to achieve this quantitative and qualitative leap forward in terms of distance learning activities, the Moodle (Modular Object-Oriented Dynamic Learning Environment) platform was selected.

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).

The aim is to continue the work previously carried out by teachers of the BNSE subject [3] to analyse the impact of changes in the subject due to its adaptation to the EHEA.

1.1 Statement of the Problem

It was the teachers of this subject who initially proposed using new digital tools to promote, facilitate and improve the quality of teaching in preparation for future implementation of the subject on an official university degree course adapted to the EHEA.

The initial idea arose from the need to document and assess the academic progress of students. The proposal consisted of setting activities to be carried out on the Internet using a student folder or portfolio. The work collected in the portfolio would be subject to evaluation in order to facilitate student assessment.

1.2 Objectives

The main objective was to determine which virtual learning tools would contribute to improving quality in teaching, whilst at the same time facilitating management of teaching practice.

These tools would need to be adapted to the particular needs of the BNSE subject, as they would have to enable students to acquire the necessary criteria for constructing buildings with a view to professional practice in the field of constructing non-structural systems and elements.

1.3 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 five 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.

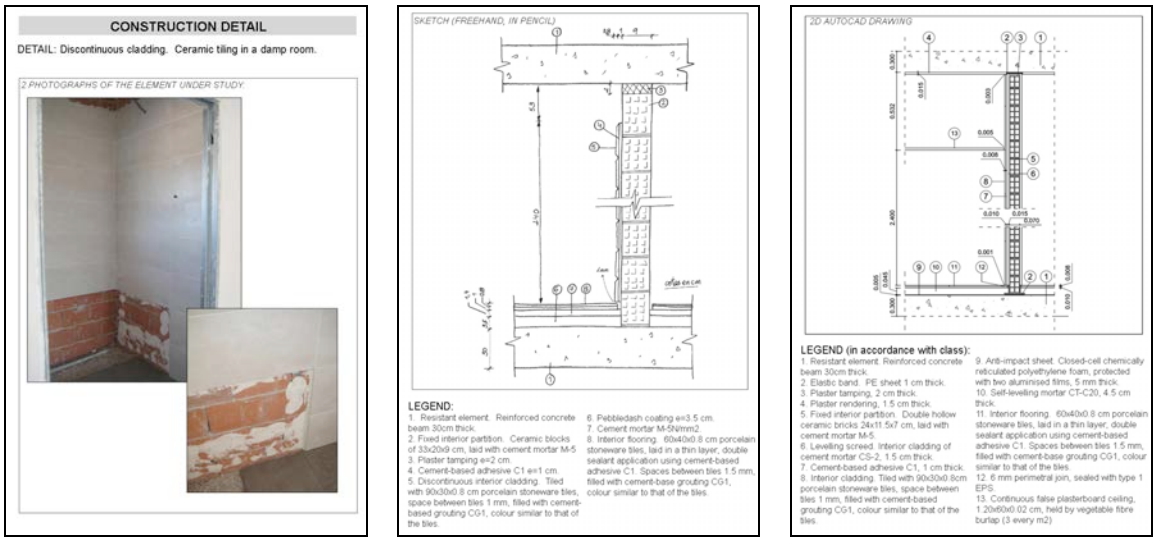


Fig. 1. Example of documents to be created for each construction detail.

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 [4] 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 [5] [6], since allocation of all possible individuals in a population was comparable.

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) [5] and García (1999, p.142) [6].

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.

A complete list of the numerous activities that can be carried out using Moodle was drawn up and those best suited to the needs of the BNSE subject were selected. These included:

- The Assignment module: designed to enable students to send in any work produced while carrying out an activity, either individually or in groups. The work is attached in digital format, whether it is a written text document, a graphic document (vector or image), video, software, or any other type of information that can be saved as a computer file.
- The Workshop module: designed in the same way as the Assignment module but with the added feature that students are involved in the evaluating the assignment. The assignment can be assessed by the student who produced it (self-assessment), by peers (peer assessment) and by teachers who grade the assignments and analyse the student assessments.

Fig. 2. Example of the UA Moodle environment for the BNSE subject.

The simplest module to implement is the Assignment, due to its options and goals settings. The Workshop Module is more complex to set up as it permits different marking strategies to establish the relative importance of the assignment mark and the assessments received; to determine the number of assessments to be carried out by each student and to set assignment submission and assessment periods, among other possibilities.

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.

2.3 Instruments

In order to collect data on study participants, a survey was conducted during April and May 2011, in which 125 students participated. The survey was used to collect data on demographic variables of the

study population, aspects related to the subject in terms of attendance and participation, time devoted to study, source documents used for study, etc.

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 [4] on the three years of the TA degree course in the academic year 2010-11.

The answers to a selection of questions are given below, and refer to qualitative variables: attendance, class participation, tutorials and study material.

Table 1. List of questions about level of participation in the subject.

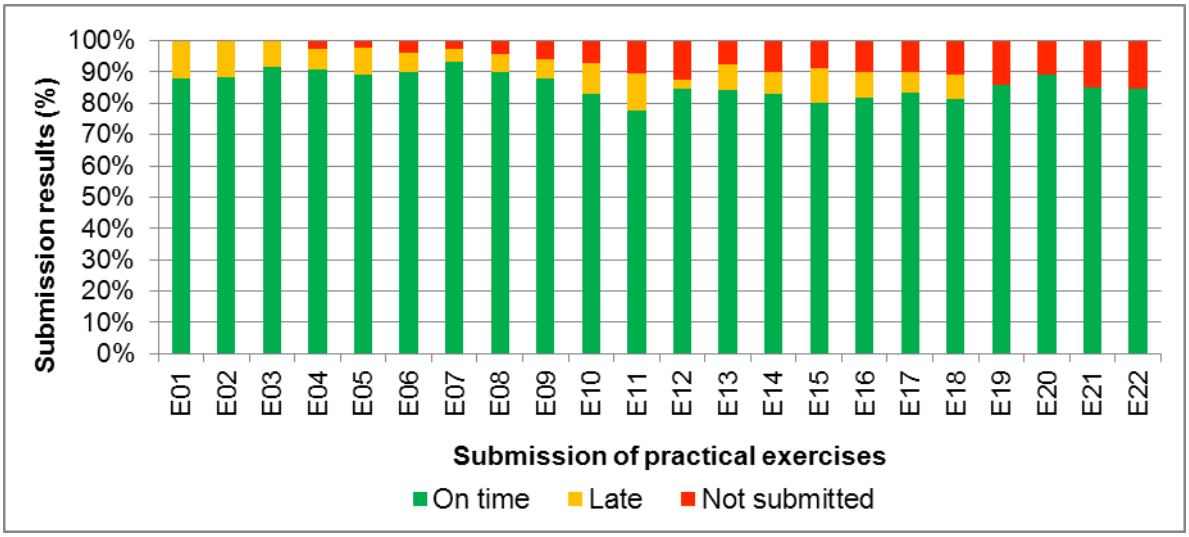
Question	Never	Almost never	Sometimes	Almost always	Always
7.- Did you attend classes regularly?	0%	2%	2%	26%	70%
8.- Did you participate actively in class?	4%	14%	48%	24%	10%
9.- Did you attend face to face tutorials throughout the course?	18%	30%	44%	6%	2%
10.- Did you take part in virtual tutorials throughout the course?	10%	27%	41%	16%	6%
16.- Did you look for information to complete the details for the construction project file?	2%	3%	19%	36%	40%
12.- Which materials did you use to study the subject? (tick those that you used					
Class Notes	100%				
Books	24%				
Journals	5%				
Web pages	75%				
Scientific articles	1%				
Technical Regulations	74%				
Final year projects	6%				
Doctoral theses	0%				
Others	25%				

Source: by the authors.

3.2 Level of compliance with deadlines for submitting assignments

To analyse compliance with deadlines for submitting weekly assignments carried out using the Moodle platform, three categories were considered: how many students in the study population submitted each assignment within the deadline, how many did so after the deadline and how many did not submit some of the work.

Table 2. Percentage of assignments submitted on time, late and not submitted.



Source: by the authors.

On the basis of the above data, and after performing a linear regression for all possible combinations, using "time/weeks" as the independent variable (identified by the 22 assignments) and each submission option (in accordance with the previous classification: on time, late and not submitted) as the dependent variables, we found a strong positive relationship between the variables "time/weeks" and "number of activities not submitted" ($r = 0.9426$, $R^2 = 0.8884$; $p = .000$). 88% of the variation in the "number of activities not submitted" is explained by the linear relationship with the variable "time/weeks". In other words, as the academic year progressed, failure to hand in coursework increased.

3.3 Assignment assessment

The Assignment Activity can only be assessed by the teacher, after evaluating the document submitted by the students and assigning a numerical value indicating the degree to which the exercise had been completed satisfactorily. The present problem lies in the large number of students, greatly impeding correct assessment of the exercises, since this is not an automated process.

Furthermore, difficulties were encountered in the assessment of exercises consisting of text documents and graphic information (drawings). This could be solved by establishing an assessment matrix or rubric, which would enable assessment to be conducted using a system of scales, thus facilitating the assessment process.

This could be achieved by incorporating the Workshop Activity, since this allows an assessment matrix to be established for marking the assignment, as well as allowing the students themselves to participate in the process It would therefore be possible to share out the assessment work among all the students, while the tutor provides a mark using the rubric, thus unifying the criteria.

As there are three parts to the construction project file (sketches, scale drawings and three dimensional drawings), three different assessment rubrics were drawn up. The generic matrix is given below.

Table 3. Assessment matrix.

Item	Levels	Options	Weighting
1) Does the construction project file include all the minimum information required?	2	Yes / No	0.5
2) Is it possible to gain a clear understanding of the construction element from the two photographs provided?	2	Yes / No	0.25
3) Has the sketch been scanned correctly? In other words, is it clear, crisp, without pixelation, etc.?	2	Yes / No	0.25
4) Does the sketch include the identifiers given in the legend, are the dimensions correct and proportional?	2	Yes / No	0.5
5) The complexity of the sketch is:	5	Very Poor / Excellent	1.5
6) Are all elements of the construction detail defined in the legend?	2	Yes / No	1.0
7) Does the explanatory file define the regulatory requirements/demands that affect the detail?	2	Yes / No	1.0
8) In the explanatory file, is the "analysis of the existing solution" correctly explained and reasoned?	3	Good / Poor	1.5
9) In the explanatory file, is the "proposed solution" defined properly?	3	Good / Poor	1.5
10) The overall assessment of the construction project file is:	5	Very Poor / Excellent	2.0

Source: by the authors.

3.4 Competencies to be acquired through coursework

The competencies established for the subject in the degree approval report [7] are required in professional practice to partially achieve objectives related to supervising the material execution of building works.

Core competencies:

G-12. Computer and information competencies.

G-13. Oral and written communication skills.

Specific competencies:

E-7. Ability to identify construction elements and systems, define their function and compatibility, and their implementation in the construction process. Propose and solve construction details.

E-9. Capacity to identify the causes and symptoms of building damage, propose solutions to avoid or rectify pathologies and analyse the service life cycle of building elements and systems.

E-10. Ability to participate in the rehabilitation of buildings and the restoration and conservation of built heritage.

E-12. Knowledge of environmental impact assessment in construction and demolition processes, of sustainability in construction, and the procedures and techniques used for assessing the energy efficiency of buildings.

E-13. Ability to apply technical regulations to the building process, and to create technical specification documents related to construction procedures and methods.

The set coursework is aimed at fostering the following competencies, which have been ordered according to the different stages necessary for the completion of each construction project file.

Table 4. List of competencies to be acquired through coursework.

Assignment	Competence acquired
Site visit	Identify building elements and systems (E-7)
Find information in bibliographical sources	Computer competencies (G-12)
Freehand drawings	Skill in graphic expression.
Description of the components/parts of the construction detail	Define the function and compatibility of the elements and/or systems (E-7)
Critique of the solution adopted (observations)	Ability to apply technical standards to the building process (E-13)
Description of the procedure for executing the construction detail	Ability to describe construction procedures and methods (E-13) Define construction systems in the construction process (E-7)
Take appropriate photographs to document the detail	Create a technical specification document for construction procedures and methods (E-13)
Creation of a construction project file	Create a technical specification document for construction procedures and methods (E-13) Written communication skills (G-13)
Creation of a final document (in digital doc or pdf format)	Computer competencies (G-12)
Delivery of documents via a digital learning environment	Computer competencies (G-12)

Source: by the authors.

Not all the competencies proposed in the future degree are included, since the present course programme (amended 1999 course programme) considers contents rather than competencies.

3.5 Advantages and disadvantages of the types of activity

Following completion of the entire academic process, a review of the Assignment and Workshop activities proposed identified several positive and negative aspects:

Table 5. Advantages and disadvantages of the Moodle platform Assignment and Workshop activities.

	Assignment Activity	Workshop Activity
Advantages	Students' theoretical knowledge is directly applied to practical experience of construction work. Students work in groups, with the commitment that this entails. Students are required to find information from bibliographical sources and regulations. Students learn to use the software commonly employed in professional practice. Teachers exercise greater control over the time students devote to the subject. The deadlines for starting and completing assignments enable students to plan the time required for the work, encouraging compliance with deadlines. Sequencing of assignments throughout the course promotes continuous work rather than sporadic efforts during the year. The date on which work is submitted is recorded for subsequent monitoring and supervision. Availability for consultation at any time, anywhere.	
		An improvement in the quality of work was observed when peer assessment was implemented. Competitiveness is encouraged, since students can compare their work with that of their peers. Critical thinking is encouraged by having to give a personal assessment of the mark awarded for work by peers. The use of a rubric allows for faster, more objective assessment.
Disadvantages	The first and most direct disadvantage is the increased workload that assessment implies for teaching staff. It is necessary to prepare the set activities. It is only suitable for small groups of students.	The activities to be carried out require more preparation. Teaching staff must establish work goals clearly and specify the marking criteria (rubric). It is necessary to learn how to use the software environment.

Source: by the authors.

4 CONCLUSIONS

Having analysed the Assignment and Workshop activities, we conclude that the latter 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.

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 submitting and monitoring assignments 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.

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.

The main problem we encountered was the large number of students. This situation rendered it impossible to take a more personalised and learner-centred approach, which is necessary in order to improve the quality of university education.

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