Analysis of the results of the continuous assessment in the adaptation of the Universidad Politécnica de Madrid to the European Higher Education Area

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***Abstract**: In this paper, an objective analysis of the continuous assessment under the application of the European Higher Education Area (EHEA) in four courses of different Schools at the Universidad Politécnica de Madrid (UPM) for more than three years was carried out. Our work hypothesis (the success of students following continuous assessment would be greater than those following the traditional final assessment) has been confirmed in three out of the four subjects analysed. Thus, the percentage of passed students increased from 55.6 to 85.3% when the continuous assessment was applied and the average grades increased 1.62 points. This better performance was shown regardless of the type of subject or degree, as well as of the amount and sort of assessment tests.*

1. Introduction

The Bologna Declaration (European Ministers of Education, 1999) has promoted an effective way of testing student achievement and offered a methodology for both measuring their performance and using the results to improve the success of the students during the academic year. The application of the Bologna process to the Universidad Politécnica de Madrid (UPM) has given the students the opportunity to play a very important role in the teaching and learning process, to monitor their achievements and to visualize their progress in each course. The continuous assessment has enabled the students to understand the areas in which they are having difficulty and to concentrate their efforts in those areas. Therefore our work hypothesis is that the proportion of success for students following continuous assessment will be greater than for students following the traditional final assessment.

The mGIE Competencies (http://mgie.eui.upm.es) is an Educative Innovation Group at the Universidad Politécnica de Madrid which works in the development of new learning and assessment methodologies as well as in the study and analysis of generic competencies. Besides, the members of the group have acquired some experience in continuous assessment. These members work in four different Engineering Schools of the University: Agriculture, Computer science, Forest and Telecommunication.

The objectives of this paper have been to analyse the effect of continuous assessment on academic performance. The analysis has taken into consideration more than three years of application of continuous assessment to four courses of four different Engineering Schools of the Universidad Politécnica de Madrid (UPM).

The paper is organized as follows. In this section we describe the background and the theoretical framework. Section 2 describes the number of participants that have taken part in the project and the way that continuous assessment and data analysis were carried out. Section 3 presents the study results as well as a discussion about them. In Sections 4 we present the main conclusion of this work.

1.1 Background

At the UPM the education system is undergoing a positive transformation from the traditional teaching and learning system (TTLS) which has failed to motivate students for further learning into novel systems based on students' required workload to achieve the objectives of programs. While in the TTLS credits are given for student workload in class without taking into account their own study hours after class, in the student-centered learning system used in the UPM, credits can only be obtained after successful completion of the required work and also after the appropriate assessment of the achieved learning outcomes. In short, the above-mentioned student-centered learning system is an active learning system based on the application of the European Credit Transfer and Accumulation System (ECTS) (European Commission, 2008a, 2008b) to the UPM.

Therefore, as the current emphasis is laid on understanding and measuring student learning rather than on teaching (Qualters, Sheahan, Mason, Navick, & Dixon, 2008), the content-centered approach (Lara, 2008) is soon-to-be obsolete and the present higher education system is moving on to the student-centered approach (Lara, 2008). In the latter, developing students' competences is of utmost importance, rather than teaching, together with the effective use of collaborative and cooperative learning methodologies (Mourtos, 1997; Finger, Gelman, Fay, & Szczerban, 2006). On the one hand, students' attendance to class has increased with the student-centered system compared to the TTLS (Steward, Mickelson, & Brumm, 2005). Finally, continuous assessment has two main advantages: 1) it helps students assimilate the subject's knowledge gradually along the academic year; and 2) if students pass all their continuous assessment tests, they won't have to do the final test.

This transformation process of university teaching is currently taking place all around the world, not just in Europe. This way improvements are being obtained in learning outcomes through an approach focused on students, continuous assessment and the evaluation of competences by applying systems such as ABET (American Accreditation Board of Engineering and Technology), which are no longer so new, to Asian Universities (Rashid, Mohamed, Abdullah, Zaharim, & Masodi, 2007) as well as to American Universities (Mead, Turnquest & Wallace, 2006).

2. Method

2.1 Participants

Students from four Engineering Schools of the UPM have taken part in this study. Table 1 shows the courses that have participated in the research and their main characteristics.

2.2 Procedure and Measurements

Assessment strategies are different in each of the four subjects showed in Table 1, although they are not described in this paper for reasons of space. However, all of them have changed from traditional teaching with a final evaluation system to a continuous assessment using active learning system. Table 2 shows in short the procedures to carry out the assessment of students' knowledge for the academic year 2007-2008. The importance of these procedures in the final grade is shown in each box (empty boxes indicate that this kind of test has not been done in that subject). In the teaching and learning process active learning methodologies have been used. For example, in OS-I some handouts have been given out as a consequence of learning with Problem Based Learning (PBL) (Dabbagh and Jonassen, 2000) and all laboratory exercises, as a final product of Cooperative Learning (CL) (Johnson, Johnson, and Smith. 1998; Pérez, García & Muñoz, 2008).

Table 1 Courses in the research

Title	Agriculture Engineering	Computer Science Engineering	Forest Engineering	Telecommunication Engineering
Course	Animal Production II (AP-II)	Operating Systems I (OS-I)	Technical Drawing (TD)	Analysis of Circuits I (AC-I)
Type	mandatory	mandatory	mandatory	mandatory
Academic year/ term	4º /2º	2º / 2º	1º / annual	1º / 1º
Credits - ECTS(*)	5-7 ECTS	4.2 ECTS	7 ECTS	7.14 ECTS
Size of group	[40-100] students	[25..40] students	[25..30] students	[39..94] students
Number of groups	4	[5..8]	[2..4]	8
Average age of students	23.4 years old	24.2 years old	18.6 years old	19 years old
Women/men percentage	54% vs 46%	13% vs 87%	33% vs 67%	30% vs 70%

(*)ECTS: European Credit Transfer and Accumulation System. At Universidad Politécnica of Madrid, 1 ECTS = [26..27] student working hours.

Table 2 Elements in the assessment

2007-2008	Exam paper	Lab exercises	Test	Handouts
Animal Production II	63.0%	10.0%	4.5%	22.5%
Operating System I		20.0%	20.0%	60.0%
Technical Drawing		48.5%	25.0%	26.5%
Analysis of Circuits	67.5%	25.0%	7.5%	

On the other hand, exam papers are partial exams. Two partial exams were done in AC-I: the first one was taken in the middle of the term (representing 30% of the grade) and the second partial exam was done during the last week of the term (it represented 37.5% of the grade). Four partial exams were also done in the subject AP-II, each of a different type of production, representing the highest grade percentage. In the subject TD two partial exams were also done. Many of the activities had to be handed over learning platforms. Moreover, at the UPM those students whit a poor performance along the semester will have the opportunity to sit for a final paper-based exam. Besides, both individual and group handouts have been done in all of the subjects. For instance, in OS-I 14 from the 25 handouts given out to students were made individually and the rest (11) were carried out in group. In the subject TD all of the handouts were done by using CAD (Computer Aided Design). Regarding percentages, 63% of the handouts were done in class (the rest were carried out at home) and 35% represents group handouts. In AP-II four different lab exercises and about 30 different handouts, both in group and individually, on-site or on-line, were developed along the course and accounted for 10% and 22.5%, respectively. The self-assessment test of the learning platform was promoted with a 4.5%. Finally, to pass the course students must get a minimum grade in each of the different tests.

2.3 Data analysis

Data were analyzed using the procedures of the SAS software (SAS Institute, 1985). The grades of each course (from 0 to 10, being 5 the minimum grade for passing the subject) were analyzed by means of an analysis of variance following the GLM procedures because of the imbalanced number of data. The least square differences using a multiple t-test were used to compare means. The logistic regression (GENMOD procedure) was used to analyse the percentage of passed students assuming a

binomial distribution. Means were compared using a protected t-test, and differences were considered significant at P<0.05.

3. Results and discussion

This study included a total of 8352 students (Table 3) of four subjects given in four faculties of the Universidad Politécnica de Madrid for a period of seven years. This implies an average of about 300 students per course and year, with a maximum of 670 students in the subject AC-I and a minimum of 80 students in TD. The number of groups per course ranged from two to eight (Table1); therefore, there was an average of 66 students per group. The number of students has followed a downward trend in all the courses over the years (from 380 to 227 on average, from the year 2002-2003 to the year 2007-2008, respectively) as a consequence of the higher number of faculties in the city and the lower population growth.

Table 3. Academic data. Year boxes in bold represent continuous assessment.

Course / Faculty	Academic year	Registered students	% Non attending students	% Passed Students[1]	Grade (or score)	
					Mean	Std[2]
Animal Production II Agronomy	2001-2002	138	7,20	93.8^{a}	6.24^{b}	1,16
	2002-2003	411	12,40	71.4^{c}	5.59^{c}	1,61
	2003-2004	369	14,90	67.5^{cd}	5.65^{c}	1,85
	2004-2005	340	18,80	62.7^{d}	5.13^{d}	2,12
	2005-2006	**244**	**20,90**	**80.8^{b}**	**6.86^{a}**	**2,00**
	2006-2007	**235**	**12,80**	**87.8^{ab}**	**6.36^{b}**	**1,51**
	2007-2008	**204**	**13,20**	**91.0^{a}**	**6.56^{ab}**	**1,43**
Operating System I Computer Science	2001-2002	347	38,30	25.7^{d}	2.80^{c}	2,29
	2002-2003	338	38,80	21.3^{d}	2.86^{c}	1,75
	2003-2004	351	43,30	41.2^{c}	2.95^{c}	2,15
	2004-2005	275	48,70	20.6^{d}	3.27^{c}	1,60
	2005-2006	**244**	**28,70**	**63.8^{b}**	**5.20^{b}**	**1,80**
	2006-2007	**210**	**32,90**	**69.5^{b}**	**6.40^{a}**	**1,30**
	2007-2008	**159**	**21,40**	**93.6^{a}**	**5.30^{b}**	**3,19**
Technical Drawing Forestry	2001-2002	157	10,80	66.4^{b}	6.18^{c}	2,41
	2002-2003	100	16,00	78.6^{b}	7.12^{bc}	2,40
	2003-2004	147	21,10	72.4^{b}	6.21^{c}	2,12
	2004-2005	**106**	**16,00**	**94.4^{a}**	**7.65^{ab}**	**1,47**
	2005-2006	**89**	**12,40**	**100.0^{a}**	**8.29^{a}**	**1,03**
	2006-2007	**80**	**10,00**	**100.0^{a}**	**7.23^{abc}**	**0,93**
	2007-2008	**97**	**34,00**	**42.2^{c}**	**4.52^{d}**	**1,88**
Analysis of Circuits Telecomunication	2001-2002	560	18,80	38.0^{bc}	3.94^{ab}	2,01
	2002-2003	670	21,50	38.0^{bc}	3.99^{ab}	1,92
	2003-2004	582	22,90	41.0^{ab}	4.12^{a}	1,97
	2004-2005	484	36,40	27.9^{d}	3.45^{b}	1,78
	2005-2006	**524**	**34,40**	**39.5^{abc}**	**3.99^{ab}**	**2,03**
	2006-2007	**443**	**45,40**	**47.5^{a}**	**4.26^{a}**	**1,88**
	2007-2008	**448**	**33,90**	**33.4^{cd}**	**3.48^{b}**	**2,15**

[1]Over presented students, [2]Standard deviation, $^{a, b, c}$ Means within the same column and section with no common superscript are significantly different ($P < 0.05$).

The percentage of students who did not follow the course (non attending students, Table 3) was on average 24%, with a higher percentage in both OS-I (36%) and AC-I (30%). There is no clear relationship between the number of students who did not attend classes and the evaluation method used. However, negative correlations among the percentage of these students and both the percentage of students who passed and the average scores were established ($r = -0.78$ and -0.76, $P<0.001$, respectively). This means that those students who did not feel prepared to pass the whole course, dropped out during the current year. This produces imbalance and heterogeneity along the years in nearly all of the courses. Thus, for example in AP-II there is a low percentage of non attending students in the year 2001-2002 because they belong to the first year of a new studies plan who got to the fourth year, completing one course per year and thus, being the best students of that year.

The percentage of students who passed was 61% on average, but with a great difference among courses. Whereas the percentage of students who passed was over 79% in TD and AP-II, that of AC-I and OS-1 was 36% and 47%, respectively. Some previous studies in our university showed significant differences among the results obtained in 3-year and 5-year degree faculties, which were related to the average score of students entering university (TD and AP-II are given in 5-year degree schools and OS-I and AC-I, in 3-year degree schools). There were significant differences within a course in the percentage of students who passed. In general, the change from a TTLS to continuous assessment gave place to an important increase in the percentage of those students who passed (for AP-II, OS-1 and TD). However this higher percentage was clearly maintained just for AP-II and OS-1 courses. Concerning TD, the decrease in the percentage of students who passed during the year 2007-2008 was the result of the habitual control imposed to discover plagiarism. In AC-I, however, no clear conclusions can be drawn.

Scores in Table 3 represent the ordinary evaluation; therefore, it does not include the extraordinary evaluation in September. Just like the percentage of students who passed, the average scores of students varied significantly along the years, and mainly after the application of continuous assessment. Thus, for AP-II the average score increased in almost one point from 5.5 to 6.5 (out of 10) comparing the three years before the application of continuous assessment to following years (year 2002-2003 to year 2004-05). It must be taken into account that the year 2002-2003 was uncommon for AP-I, since it was the first one regarding both the total number of students and the number of students who passed (see the second paragraph). In the case of OS-1, the average score when assessment was not continuous amounted to 2.97 whereas the average score during the three courses in which continuous assessment was applied is equivalent to 5.63. Regarding TD, figures are 6.5 from the year 2001-2002 to the year 2003-2004 and 7.72 from the year 2004-2005 to the year 2006-07. The year 2007-2008 has not been included due to its singularity. Not so clear differences in the average score have been noticed in the subject AC-I using one or the other assessment strategy, probably because only two groups out of eight follow continuous assessment. Surprisingly, there was no significant correlation between the percentage of students who passed and the average scores when analysed all together; however, correlation varied from 0.8 to 0.95 ($P<0.001$) when analysed within each course.

A matter that will be raised in a further paper is that this situation would take place by the time all the subjects in a course put into practice continuous assessment. It has already been mentioned that this assessment strategy implies a greater workload both for students and professors. The increased academic performance in three of the four subjects takes place in a context in which the subjects considered were the only course using continuous assessment. According to the amount of time dedicated by students to carry out their handouts, they have devoted on them more time than planned, presumably subtracting it from other subjects. Besides, this may be other reason why no significant changes have occurred in the subject AC-I. This subject is given in a course in which the other subjects make also use of continuous assessment, indicating so what could occur when all of the subjects use continuous assessment.

4. Conclusion

The main conclusion of this paper is that our hypothesis of work, which is that the amount of success achieved by students following continuous assessment will be greater than that of students following the traditional final assessment, has been confirmed in three of the four subjects considered. Besides,

this increased performance, which has been observed in the percentage of the students who passed, is shown regardless of the type of subject or degree, as well as of the amount and sort of assessment tests.

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