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Common Mistakes in the Application of Continuous Evaluation Methodologies in Spanish Universities

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1. Introduction

Since 1999, when the Bologna declaration was signed with the objective of creating a European Higher Education Area (EHEA) by 2010, a process was started to modify and adapt the teaching methodologies to this new set-up. Although this might be seen as only affecting European universities, it should be noted that America too has seen the need to modernise its teaching practices. For scientific studies, the standards of scientific education published by the *National Research Council* (NRC, 2000) have examined the contents and pedagogy of scientific learning and teaching, and new standards aimed at improving and modernizing scientific education are being developed.

It is interesting to observe how many teachers and specialists refer to alternatives to conventional lectures and tutorials as “new teaching methodologies” when most of these have in fact a long history of use behind them. For example, many lecturers call problem based learning (PBL) a “new teaching methodology” when the first written reference that we have found to its application in scientific studies dates from 1902 (Smith and Hall, 1902), more than 100 years ago.

Biggs and Tang (Biggs and Tang, 2007) write “in the days when university classes contained highly selected students, the lecture and tutorial seemed to work well enough. However, the increasingly drastic changes in the tertiary sector have redrawn the university scene –not entirely disadvantageously- for teaching quality.” We are now seeing a greater diversity in the backgrounds of students presenting themselves in our classes, with non-traditional entrance qualifications, unequal prior knowledge and experience, and different learning styles (Brown et al., 1994). Bodner indicated that the traditional view of knowledge is “based on the hidden assumption that knowledge can be transferred intact from the mind of the teacher to the mind of the learner” (Bodner, 1986), and educators only have to focus on getting knowledge into the heads of their students. It is clear that “teaching and learning are not synonymous; we can teach, and teach well, without having the students learn” (Bodner, 1986).

There is no need to find better methodologies than lectures because there is no unique and optimum teaching methodology that works for every student. The lecture is perfectly

adequate for a motivated student, but will always be insufficient for poorly motivated ones. So, the question that we have to ask as teachers is “How can we teach in a way that non-motivated students learn as motivated ones?” In this situation, it is necessary to move from passive teaching methodologies (e.g., the lecture) to active ones (e.g., PBL) as effective teaching should get the majority of students using high cognitive level processes that active students will use spontaneously (Biggs and Tang, 2007).

The main part of the methodologies that have been developed in recent years are based on the cognitive constructivism theory of Piaget, which breaks with traditional teaching models. Piaget suggests that learners cannot be given information that they immediately understand and use. Instead, people must build their own knowledge through experience, which enables them to create mental frameworks in their heads. These schemes are changed, enlarged, and made more sophisticated through two complimentary processes: assimilation and accommodation. Students should be able to build their own comprehension without repeating parrot fashion those concepts that have been explained to them or that they have read.

It is a characteristic of human nature that we try to find meaning, order and coherence in all the situations we face, including those where we do not have a part, or the whole, of the information required. Our goal as teachers is to achieve that students act in a similar way during their learning process. This is not an easy task, and it becomes more complex when we have to deal with poorly motivated students. To provide more meaningful learning for our students, we must use teaching methodologies that are both appropriate to the particular field of learning and which encourage the use of critical thinking. Those methodologies only requiring that student seats down to receive information passively must be avoided (McKeachie, 1986).

In the specific case of the Spanish university system, the almost complete lack of pedagogical formation of the university teachers has presented an important problem in this process. In Spain, university lecturers are not required to have any specific pedagogical formation before starting to teach at undergraduate level although primary and secondary school teachers do receive full training. It should be noted that during the last few years some Spanish universities, as is the case of the University of Girona, have been introducing different, non-mandatory, post-graduate courses devoted to university level teacher training.

Most teachers who have been working with different “alternative” methodologies since 1999 have been applying these methodologies without having received the necessary theoretical and practical background. This process of self-formation has gone largely unrecognized by the institutions.

2. Assessment Methodologies

The most complex, and least developed, issue regarding the application of alternative methodologies is how to asses students fairly. Continuous evaluation systems seem to be the most widely accepted by the university community in our country. This option seems to be, a priori, the fastest and simplest way to adapt traditional evaluation methodologies, which are based around a final written assessment, to the alternative methodologies. For most subjects, this apparently “simple” adaptation process has resulted in the “simple” application of different short written assignments during the term and a final assessment at

the end. The mark of the students usually requires the use of a spreadsheet to calculate the final end-of-term mark giving each assessment a specific percentage value as part of the whole mark. The final exam is given a significantly greater weighting in the final calculations. Furthermore, students are normally required to pass this final exam in order to pass the term. Given this situation, it is not surprising that students wonder why they are required to perform so many assessments during the term when in the end, as with traditional evaluation, their success is dependent upon an end of term pass. This failure to provide a clearly distinct model is one of the main student criticism of the Bologna system as they see it as only increasing the level of dedication that they are required to make.

It is well known, as Boud writes, that “assessment methods and requirements probably have a greater influence on how and what students learn than any other single factor” and that “this influence may well be of greater importance than the impact of teaching materials” (Boud, 1988). Unfortunately, conventional evaluation methods are not usually adequate for alternative teaching methodologies. Therefore, our assessment strategies need a major overhaul to adapt to the changing conditions in higher education (Brown, 1999).

Brown and Knight have suggested a wide range of reasons why teachers assess students (Brown & Knight, 1994). The following might be emphasized:

- provide feedback to students so they can learn from mistakes and build achievements
- classify or grade student achievement
- enable students to correct errors and remedy deficiencies
- motivate students and focus their sense of achievement
- consolidate student learning
- help students to apply abstract principles to practical contexts
- estimate students’ potential to progress to other levels or courses
- guide selection or option choice
- give teachers feedback on how effective we are being at promoting learning

An appropriate assessment method has to be able to *describe* (those aspects under discussion), *assess* and *repair* (learning mistakes and deficiencies). Traditional assessment methods are usually adequate for the second objective (assessment) but tend to forget the advice and support that students need to succeed in their studies (Brown, 1999). Another negative characteristic of traditional assessment methods is that evaluation usually takes place at times which are for the convenience of the academic programme or the teacher, rather than at the most appropriate moment for the development of the learning process of the student. Moreover, traditional methods based on a final assessment exam do not take into account the possibility of introducing feedback processes that allow students to be helped to solve their mistakes and deficiencies.

A continuous evaluation system should be based on *formative* evaluation, or *process* evaluation, which is a method of judging the effectiveness of a programme whilst the programme activities are taking place (*formative* evaluation focuses on the *process*) (Bhola, 1990). *Summative* evaluation, or *product* evaluation, is not completely adequate as it is a method of judging the worth of the programme at the end of the programme activities by means of a grading system. Unfortunately, institutions always ask teachers to grade students, so requiring *summative* evaluation.

We have performed a systematic and statistical study into the efficiency of evaluation methodologies using different assessments during the term together with a final assessment exam to determine their effect as a continuous evaluation methodology.

3. Methodology

The results evaluated in this study have been obtained over five academic years (Table 1). The subject taught was “Advanced Analytical Chemistry”, which is taken by students during the fifth of the eight terms that make up the Chemistry degree in the Science Faculty of the University of Girona (Spain).

Year	Students		Final Assessment	Pass Rate ^b	Marks	Pass Rate ^b
	Enrolled ^a	Sat exam	Mean (Min – Max)		Mean (Min – Max)	
2003/04	63 (23)	54	4.36 (1.67 – 7.87)	37%	4.36 (1.67 – 7.87)	37%
2004/05	62 (16)	51	4.40 (1.88 – 7.43)	37%	5.41 (2.48 – 8.16)	67%
2005/06	44 (13)	36	4.35 (1.97 – 6.88)	36%	5.82 (3.47 – 8.36)	86%
2006/07	41 (9)	33	5.41 (2.28 – 8.22)	79%	6.58 (3.76 – 9.07)	93%
2007/08	38 (2)	32	5.64 (3.67 – 7.47)	82%	6.32 (3.59 – 8.22)	94%

Table 1. Results obtained by students in the final assessment and their marks for “Advanced Analytical Chemistry”.

^a The number of repeating students enrolled in the subject is given in brackets.

^b Percentages are of the number of students sitting the final assessment exam.

Alternative methodologies were not in use during the first academic year (2003/04) evaluated: a single end of year final written exam was taken. The results obtained during this first year are taken as a reference to compare with the results in the final assessment exams of the other years, during which alternative evaluation methodologies have progressively been introduced.

A simple continuous evaluation methodology, based on different partial assessment exams during the term (at the end of each thematic block) and a final overall assessment exam at the end of the term, was used in 2004/05 and 2005/06. During this period, no feedback processes from the results obtained in the partial assessments were recorded. The final mark was determined by the simple summing up of the marks (each with its specific percentage

weighting). The homework of the students solving numerical problems and their oral presentation of practical cases were also introduced in the calculation of the final mark. A self-correction process of the partial assessments, by the students themselves (individually and in small groups), to check the tests was introduced during 2006/07. Students have to discuss their answers with other members of the group to find the most appropriate one. They then have to propose their individual marks for the test to the teacher. Afterwards, tutorials of small groups are held to review the students' mistakes and misconceptions. This methodology allows to focus partial assessments exams as review exercises of the learning process of the students, rather than as just a simple exercise in grading. As a result, teachers obtain useful information about the knowledge and skills being acquired by students. The most important benefit of this methodology is that this feedback process allows teachers to detect the skills and knowledge that are not being adequately assimilated by students, and so solutions to correct them can be applied in time. In order to compare and evaluate the effectiveness of the changes introduced in the learning process of the students, equivalent final assessments have been applied each year. These have been prepared following the same format as the one used during the first year of the study (2003/04). An effort has been made each year to prepare final assessment exams that have the same number of questions as well as a similar level of difficulty. Table 1 shows the results obtained by students in the final assessment exams, with the marks obtained each year.

4. Discussion

Statistical evaluation of the results presented in Table 1 show that there is a significant difference between the students results obtained each academic year in final assessment exams. Moreover, there is also a significant difference in the final qualifications of the subject when the percentages applied in the spreadsheet calculations are modified.

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	63.8	4	15.96	9.44	0.002
Within Groups	339.8	201	1.69		
Total	403.6	205			

Table 2. Results of the ANOVA test for the marks of the final assessments, grouped by academic years.

An ANOVA test has been applied to compare the results in the final assessment exams grouped by academic years and a significant difference ($P=0.002$) between the marks is observed (Table 2). The *Scheffé test*, applied to detect the source of differences, reveals that the marks fall into two groups (Table 3). The first group contains marks obtained in 2003/04, 2004/05 and 2005/06 ($P=1.000$). The second block has marks obtained during the last two academic years studied ($P=0.959$). During the first academic year studied, 2003/04, sixty-three students were enrolled in the subject (23 were repeating the year, 36.5%). The students' mean mark in the assessment was 4.36 out of 10 (Table 1) and 37% of the students (20 students) passed the subject (percentage

calculated from the students who sat the test). All 40 new students sat the assessment exam and all the students that passed the exam, 20 students, were from this group. So, the pass rate of the group of student that sat the exam for the first time was 50%. Similar percentages were obtained in previous years for this subject: the inspection of academic records showed that in the previous 10 years the pass rate has ranged from 42 to 58%. A pass rate of around 50% must be considered very low when we take into account that this is a fifth term subject. At this level, students have taken all basic chemistry subjects and several advanced topics. The background of chemical knowledge of these students should be more than enough to obtain a much higher pass rate in this subject and so we are led to conclude, at least in the case of this subject, that an evaluation methodology based exclusively on final assessment is not appropriate. A further weakness is that any pedagogical conclusions which are drawn by the teacher on the bases of the results can only be applied in later years, the present students will obtain no benefit from this.

(I) Year	(J) Year	Mean Difference (I-J)	Sig.
2003/04	2004/05	-0.04325	1.000
	2005/06	0.01046	1.000
	2006/07	-1.04633	0.014
	2007/08	-1.28259	0.001
2004/05	2005/06	0.05371	1.000
	2006/07	-1.00308	0.023
	2007/08	-1.23935	0.002
2005/06	2006/07	-1.05679	0.029
	2007/08	-1.29306	0.003
2006/07	2007/08	-0.23626	0.971

	Year	n	Sub-Group for $\alpha = 0.05$	
Scheffé ^(a,b)	2005/06	36	4.3514	
	2003/04	54	4.3619	
	2004/05	51	4.4051	
	2006/07	33		5.4082
	2007/08	32		5.6444
	Sig.		1.000	0.959

^a Sample size of the harmonic mean = 39,523.

^b The harmonic mean is used.

Table 3. Scheffé test results for the multiple comparison of the studied variables.

During the next two academic years, 2004/05 and 2005/06, a new evaluation methodology was tested. As indicated in the methodology section, this was based on different assessment exams during the term and a final assessment exam at the end of the term. Skills and

abilities other than the level of knowledge acquired by the student were also taken into account and were included in the calculation of the final mark of the subject (e.g., the ability to solve numerical problems was evaluated from the presentation of different handouts, and communication skills were evaluated from oral presentations made in class). It was thought that this simple way of applying a continuous evaluation methodology would increase the dedication of the students to the subject, so improving their learning. However, the application of this methodology only helped students to obtain better marks without discernable improvements in the learning process being observed (Table 1 and 2). Results in the final assessment during these two years did not show any significant difference from those obtained in 2003/04 ($P=1.000$), and a similar percentage of students (37% in 2004/05 and 36% in 2005/06) were able to obtain pass marks in the final assessment.

The increase obtained in the final marks of the subject was the result of the assessment exams performed during the term and the other marking tasks. Participation in the continuous evaluation methodology was voluntary in 2004/05. All new students ($n=46$) and 2 repeaters decided to participate in this methodology. The other 3 students evaluated only sat the final assessment. It was decided that for the students accepting the continuous evaluation methodology the term work/final assessment weighting would be 60%/40%. Marks in the final assessment exam were not found to increase, and only 37% of the students passed this test. Nevertheless, 67% of the students passed the subject due to the greater weighting of the term time assessments.

The continuous evaluation methodology was also voluntary in 2005/06 but the weighting given to the tasks evaluated during the term was increased to 70%. The pass rate in the final assessment exam remained constant (36%), but the percentage of students who passed the whole subject increased to 86% due to the greater weight of the continuous evaluation elements.

These results demonstrate that the use of a continuous evaluation methodology based on different assessment tasks during the term without any feedback process significantly increases the academic marks of the students (i.e., mean final marks are more than 10% higher than the mean marks in the final assessment exam, Table 1) and yields "better" statistics for the performance of the subject. However, the learning of the students does not improve. The level of content comprehension remains unchanged (i.e., mean marks and pass rates in the final assessment exam did not change during the first three years of this study). The most remarkable and important conclusion is the fact that an increase in the weight of the evaluation tasks performed during the term results in higher marks in the final marks.

A feedback process allowing pedagogical improvements to be made was implemented in 2006/07. This feedback was based on self-evaluation and the revision of the assessment exams by the students themselves, followed by tutorials of small number of students (typically 3 or 4). This methodology allowed teachers to detect those concepts that were misunderstood by students. The feedback process gave teachers time to attempt to find solutions to these problems whilst the academic year was still in progress. The results of the self-evaluation and revision results were used to programme tutorials specifically devoted to helping students to review and correct those concepts, skills and abilities that were poorly misunderstood. The results obtained in the final assessment exam show a significant increase in the mean marks (5.41 in 2006/07 and 5.64 in 2007/08) and an 80% or higher pass

rate each year. The weighting of the tasks along the term was maintained in a 70%, which resulted in the final pass marks reaching up to 94%.

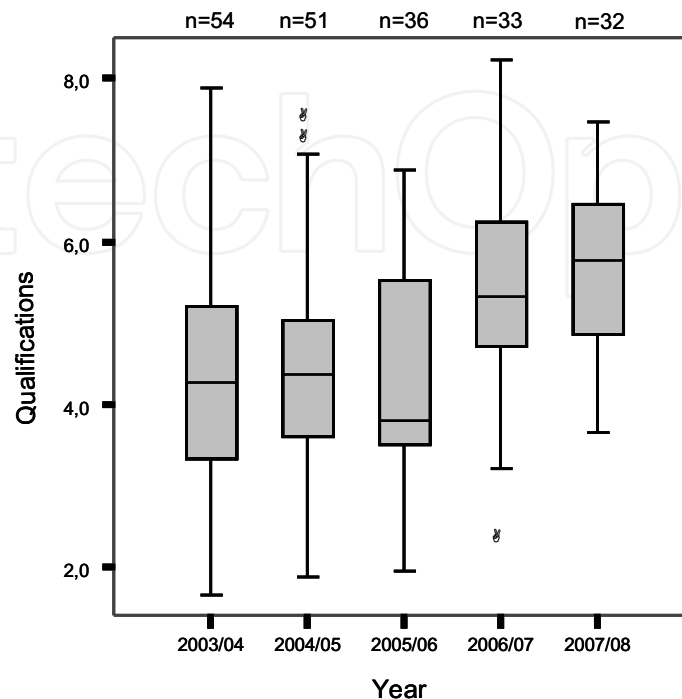


Fig. 1. Box-plot showing the distribution of the students' marks in the final assessment exams.

Figure 1 shows the box-plots with the distribution of the students' marks in the final assessment exams. The lowest mark in the 2006/07 exam was 2.28 but this should be considered an outlier. When this value is removed, the lowest mark was 3.22, almost two units above the lowest marks obtained in previous years. The lowest mark in 2007/08 was 3.67. These last two years were the only ones where the mean marks of all students were higher than 5 (as much as 10 points in the exam).

In 2006/07 and 2007/08, a survey was distributed among students at the end of the term (Table 4). This was prepared in order to obtain direct information as to the effect this continuous evaluation methodology was producing in their learning. The answers obtained from students were very positive and the following trends can be noted:

- An increase in student dedication to the subject was observed.
- Student performance was higher or equivalent to that obtained through conventional lectures.
- The presentation of assessment exams as homework exercises and the marking of them has helped teachers to check the level of knowledge assimilation and comprehension during the term.
- Students are strongly in favour of solving assessment tasks as group exercises as this gives them the opportunity to discuss and revise the subject matter. It is important to note that students are more demanding in their requirements for good and clear explanations than they are from teachers. This results in increased student dedication in the preparation of group meetings.

Question	Answers and Percentages
Hours of weekly dedication to the subject (excluding lectures).	<ul style="list-style-type: none">• 1-3 hours (44%)• 3-6 hours (44%)• 6-10 hours (4%)• Only before an exam (8%)
Dedication compared with subjects with conventional evaluation methodologies.	<ul style="list-style-type: none">• Lower dedication and better results (16%)• Higher dedication and better results (32%)• Equivalent dedication with better or equivalent result (48%)
Handing in of the assessments exams as group exercises.	<ul style="list-style-type: none">• Adequate for reviewing and increasing learning (84%)• Not useful (12%)• Did not reply (4%)
Has it been useful to work in groups when preparing the assessment exams to be handed in?	<ul style="list-style-type: none">• Yes (88%)• No, it would be better to work individually (4%)

Table 4. Answers obtained from the students in the survey about the evaluation methodology used in the subject “Advanced Analytical chemistry” in 2006/07 (n=25).

5. Conclusions

Results obtained in this study indicate that the simple application of continuous evaluation methodologies based exclusively on different assessment exams during the term and a final assessment exam at the end are not sufficient to improve the learning process of students. However, this process has been widely accepted by many lecturers in Spanish universities as a simple way of transforming traditional evaluation methodologies so that they meet the requirements of the Bologna declaration: what is achieved is greater success in the statistics for the subject. There is a close correlation between an increase in weighting being given to term time assessment tasks and higher end of year marks. This result may be well looked upon by university administrators as at first sight it would seem to represent a real improvement, which may bring with it certain advantages from their perspective. However, there it is seen quite clearly that the learning of the students is not significantly improved. In order to obtain an improvement in student learning, it is necessary to apply continuous evaluation methodologies that include feedback processes. Feedback received from assessment tasks performed during the term must be evaluated appropriately by teachers to apply corrective measures when needed. The advantage of partial assessment exams is that

teachers still have time to find solutions to problems which are encountered. This is impossible when only a final exam is given.

There are two main trends from feedback processes that have to be taken into account by teachers when trying to apply these methodologies:

1. It is necessary to consider a profound revision of the contents of subjects. It is very important to select only those contents that are really essential to student learning at undergraduate level. The current system in Spanish universities is based on overloaded programs, which are set before the beginning of each term. Lecture schedules are very tight and no time is programmed to apply feedback methodologies. It is necessary to schedule tutorials with a small number of students to review and solve students' misconceptions. Moreover, this feedback process has to be fast (just a few days). When there is an excessive delay in the feedback, students will be focussed on other topics and will not give priority to learning lessons from it (Race, 1999). This problem was detected during our first feedback process. Tutorials were scheduled two weeks after the assessment in order to allow teachers enough time to review the tests. During tutorials, students communicate to us that they did not remember the answers they had given as too long a period had gone by.
2. The larger the assessment task programmed, the greater the time needed for the evaluation work of the lecturer and the greater the pressure on teachers to produce the feedback (Gibbs, 1992). Hence, teacher dedication to the subject increases considerably when continuous evaluation methodologies are applied. Spanish university institutions need to make an effort to reduce the number of subjects that teachers have to teach each term: this does not mean a reduction in the hours given over to teaching but rather a change in how this time is used. The changes proposed to teaching methodologies in the Bologna declaration actually require a significant increase in the workload both of teachers and students. If this is not taken into account by institutions, the changes proposed by the EHEA will be a failure and there will be no other option than to return to traditional lecture-based methodologies.

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From 3rd to 5th March 2008 the International Association of Technology, Education and Development organised its International Technology, Education and Development Conference in Valencia, Spain. Over a hundred papers were presented by participants from a great variety of countries. Summarising, this book provides a kaleidoscopic view of work that is done, all over the world in (higher) education, characterised by the key words 'Education' and 'Development'. I wish the reader an enlightening experience.

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