

Considerations on the success rate in aeronautical engineering studies in Spain

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Abstract: The relationship between different learning evaluation methods and the academic success in an aeronautical engineering degree in Spain is analysed. The study is based on data about the evolution of academic achievement obtained along the last ten year, along which the evaluation and learning's methods have suffered huge changes.

Introduction

In this study we analyze the academic success of aeronautical engineering students enrolled in ETSIA (Escuela Técnica Superior de Ingenieros Aeronáuticos), as well as its relation with the different learning evaluation methods used. In the last few years the status of ETSIA has dramatically changed, from it being the only centre providing an aeronautical engineering degree in Spain, to it nowadays being one of several centers devoted to the teaching of this subject. This fact, along with the introduction of the new European Higher Education Area and the European Credit Transfer System, has introduced huge changes, especially in regard to evaluation methods. Instead of a unique final test, which was the mainstream option ten years ago, most subjects of the new degree have chosen either a very frequent assessment system based on weekly tests or a system based on a few (typically between three or five) midterm exams. It is important to remark here that this last option has been the usual method used to examine Spanish students in high school.

We present data about the evolution of academic achievement, depending on different study curricula and evaluation methods, and also a survey measuring the students' perception of the convenience of each evaluation method in terms of both the learning process and workload.

At the same time of these changes, ETSIA staff has launched a series of initiatives aimed at improving educational outcomes (see Hilario, J., Ramírez, J. et al., 2008, Ramírez J., Burgos J. et al., 2008). Their academic impact is also discussed.

The paper focuses on the first cycle of the degree, where subjects are common to all students, while the second cycle include many specialties. This fact represents a diversification of studies and complicates the combined comparison of the academic results.

Description of evaluation methods

In ETSIA, from the year 1997/98 different methods of evaluation have been implemented in a progressive way in the first cycle of the degree.

One of the main problems of the implementation of these new methods has been the high number of students per class (around 70-100), so the help of new technologies, like optical readers or interactive response system (see Ramírez J., Burgos J. et al., 2007, Ramírez J., Burgos J. et al., 2008) have made an essential contribution.

Evaluation methods

Method 1: Continuous evaluation that allow passing the whole subject (releasing tests)

This method has been implemented from 2005-06 in two subjects of the first year of the degree (see Hilario, J., Ramírez J. et al., 2008). Nowadays this method is the most used in the subjects of the first year.

Each week or each two weeks (depending on the subject), the students have to carry out with a short test (around 20-30 minutes) with practical questions about the part of the subject explained along the previous week (or two weeks). Each question of the test has three possible answers. The mark of the correct answer is +1,5 and the mark of the incorrect is -0,5, to avoid good marks for random answers. The tests are corrected using an optical reader.

If the student has a medium mark during the year upper a minimum (normally the minimum is around 6 or 7 if the maximum possible mark is 10), then he/she pass the subject and he/she doesn't have to carry out with a final test, unless he/she wants to improve his final mark.

If no more tests were performed, around the 20-25% of students would pass the subject by continuous evaluation. To increase this percentage, different options are used, depending on the subject. One option is to consider only a part of the tests (those with better marks) to calculate the final mark. For example, if there are 10 tests along the year, only the seventh with best mark are used to calculate the medium mark. Another option is to perform extra test (for example one extra test per each two or three tests, which includes the parts of subject considered in those tests), which provide a second opportunity for student to improve the mark they obtained in some of the tests.

If the student doesn't obtain the minimum mark to pass the subject, then he/she has to carry out with a final test, and the mark he/she obtains by continuous evaluation is considered as a bonus (if is higher than 5) when the final mark is calculated.

The main advantages of this method are:

- Students have to follow a continuous rhythm of study along the course, and they have to pay more attention during the classes
- If they pass the subject with the continuous evaluation, during the period of final tests they can be dedicated to the tests of other subjects
- To facilitate the coordination when there is a high number of groups. For example, in the year 2010-11 there have been 10 groups in the first year. This method imposes a rhythm of the subject that all the teachers have to follow, because all the students of the first year have to carry out with the same test each week or two weeks.

The main disadvantages of this method are:

- To prepare and correct so many tests involves a lot of work for teachers.
- If this method is implemented in more than one subject the students are under a lot of pressure every week. As well shows in Olarrea, J., Lapuerta V. & Sanz, A. (2011), although students recognize this method is good to learn they don't like to have so many tests along the course.

Method 2: Continuous evaluation as a bonus

This method was implemented in 1997-98 in two subjects of the first year of the degree. Nowadays it is used in some subjects, but it is less popular than method 1.

The methodology is very similar to the previous one. The main difference is that here the student always have to carry out with a final test, and the final mark (FM) is the mark obtained in the final test (FTM) plus a bonus corresponding to the medium mark (MM) obtained through the continuous evaluation. For example, the final mark could be calculated with an equation like this: $FM = FTM + 0.2 * MM$.

The problem is that this method has the same disadvantages than method 1 and less advantages than method 1, because the motivation of students to follow the continuous evaluation is lower than in method 1.

Method 3: Midterm exams

With this method we refer to some tests (three or four as maximum) along the subject that allow the students to pass different parts in which the subject has been divided. As we show in Olarrea, J., Lapuerta V. & Sanz, A. (2011), this is the method preferred by students.

Method 4: Final exam

The students have only a final test where they are evaluated of the whole subject. Up to the last ten years, despite seeming unfair to evaluate the whole course in an unique event, this has almost been the only method used in the ETSIA. Needless to say, this is the least valued of all them by the students

Analysis of success rate

Any student has two chances to pass a subject along the course. The success supposes that the student has reached the minimum qualification in one of them, while the failure supposes not. The failure may occur if the student has not submitted the final assessment test (not presented) or if he/she has not reached the minimum qualifications required to overcome it (failed). To measure the student's rate of success/failure the following ratios have been defined for each full course, distinguishing between the number of years that students have been enrolled in the center.

$$\text{Success (year)} = \frac{\text{Number of calls successfully overcome in considered year}}{\text{Number of students in considered year}}$$

$$\text{Failure (year)} = \frac{\text{Number of calls not passed (not presented or failed) in considered year}}{\text{Number of students in considered year}}$$

Figure 1 (a), (b) and (c) shows the success and the not success (failure) results in the first three years in absolute values while Figure 2 shows these results in relative values.

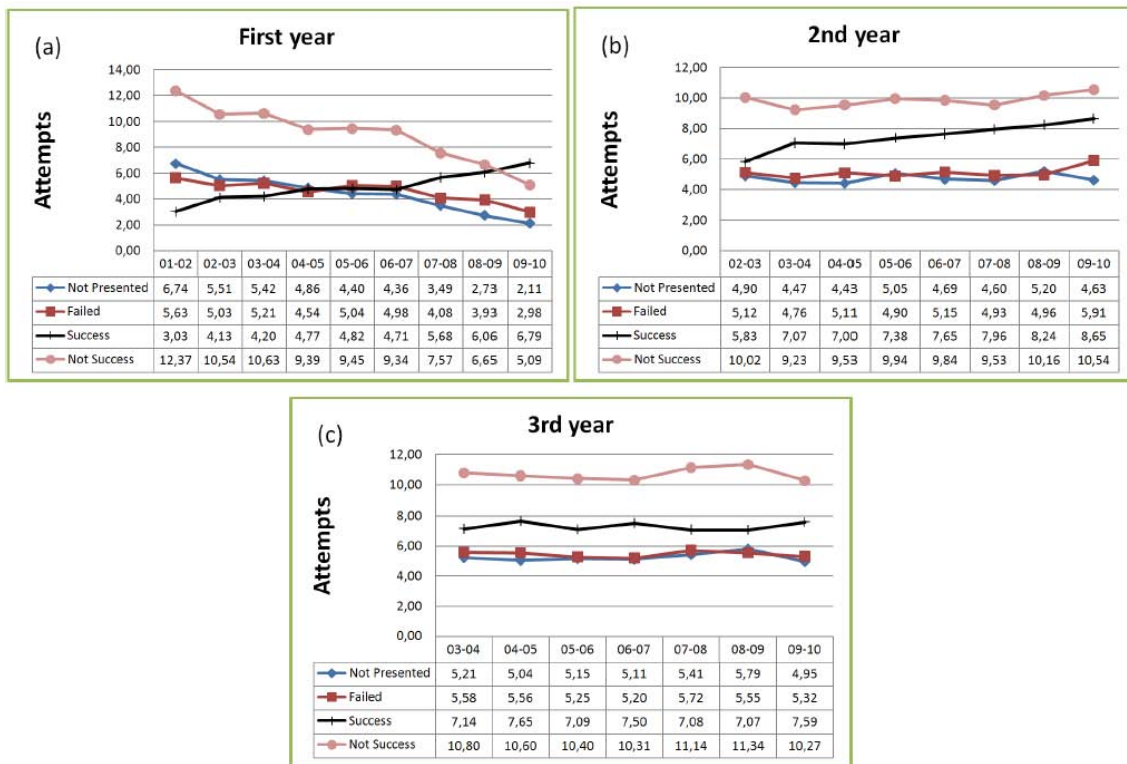


Figure 1: Rate of success/not success (failure) during (a) first, (b) second and (c) third year in absolute terms

Figure 1 (a), (b) and (c) have also a separated representation of both cause of failure: not presented or failed. The term "not presented" is used as a direct translation of the Spanish term "no presentado", indicating both the student did not show to the final exam (if this is the case) as the incomplete status in the other evaluation methods, i.e., when he has not performed any of the tasks required.

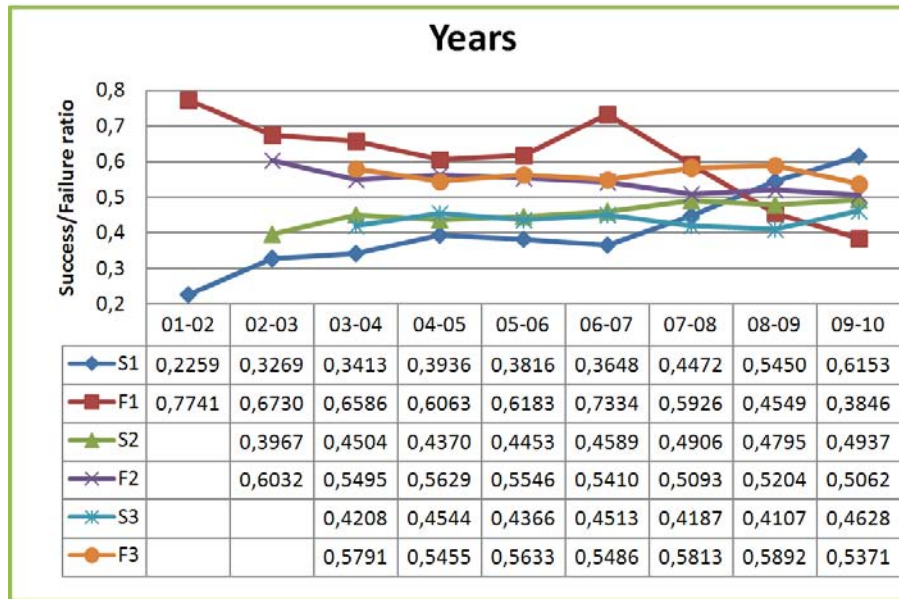


Figure 2: Rate of success/not success (failure) during first three years in relative values.

It can be observed a clear difference in the evolution of the rate of success/failure depending on the current year. The most striking values appear in the first year. In this year the success rate evolves from 3,03 in course 2001-02 to 6,79 in 2009-10, which represents an increase of 124% in ten years. On the other hand, the failure rate evolves from 12,37 during 2001-02 to 5,09 in 2009-10 and fell by 58,9%.

In fact, in 2009-10 is achieved for the first time that the number of passed subjects is greater than not passed subjects. The same analysis in the next two years shows that the success and failure ratios remain stable. The student reaches a steady state and manages to overcome roughly the same number of subjects per year.

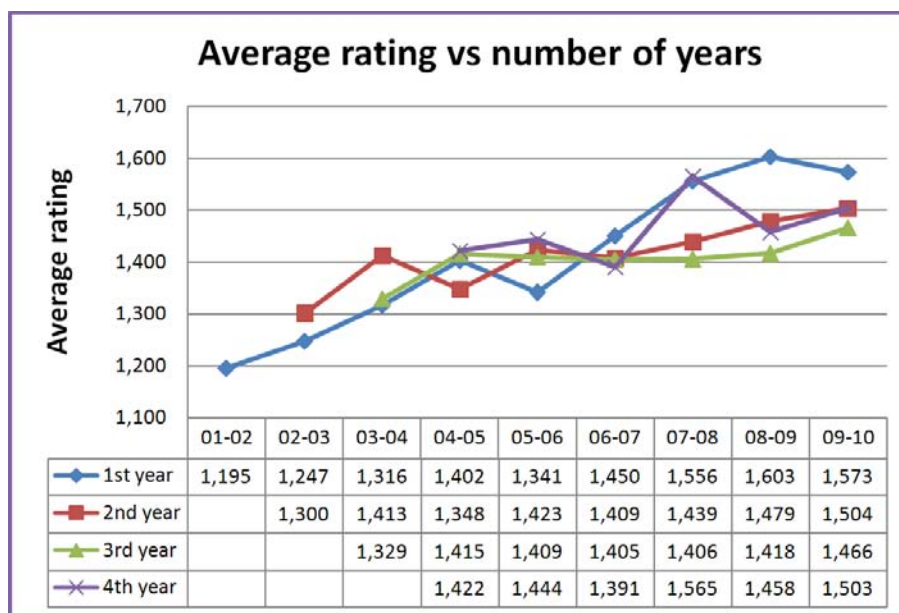


Figure 3: Average rating during the first, second and third year

On the one hand, the most difficult subjects of the degree accumulate in the second year, which justifies in part the slight decline of the success rate observed, but also the lack of appropriate advisors in the academic environment makes our students overenroll for courses they cannot adequately follow. The number of subjects in the syllabuses is too large and our students are not able to organize.

Further evidence of the results efficiency is shown in Figure 3, which represents the values of the mean scores obtained by students during their first four years in the ETSIA. These values have been obtained using the following numerical rating: 1 = passing (aprobado), 2 = good/very good (notable), 3 = excellent (sobresaliente) and 4 = outstanding (matrícula de honor), with Spanish terms in brackets.

Figures 4 and 5 show an example of particular outcomes in subjects for the first and second years. Each of the subjects depicted follow a different evaluation method: in A, method 2 until 2004/05 and method 1 later; in B, method 4 until 2005/06 and method 3 later; in C, method 4 performing a classical constructed response test until 2009/10 and in D, method 4 performing a selected response test with multiple choice from 2005/06.

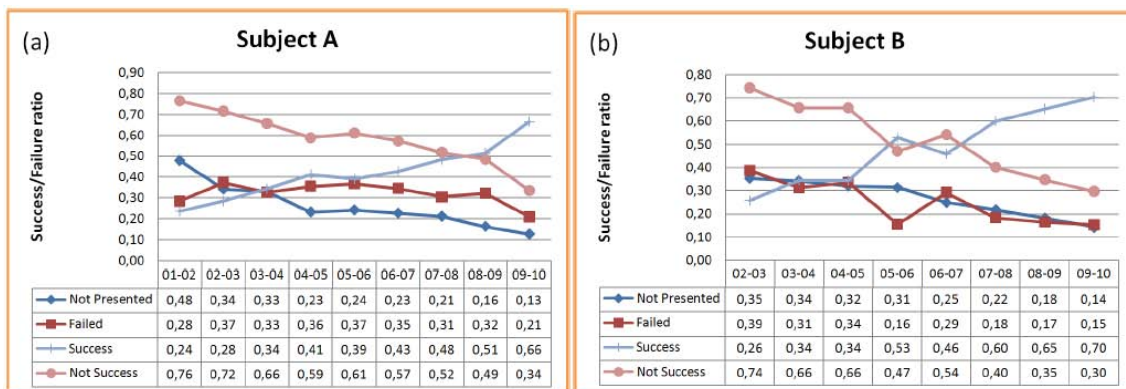


Figure 4: Success and not success ratios in sample subjects with evaluation methods 1 and 2.

Figure 5 shows that subject C, which has not incorporated any innovation in his evaluation methods nor in the test style, has not improved the success rate of students, while subjects A, B and D have made an effort to adapt to the changes in the learning and evaluation process, which seems reflect in an remarkable increasing on the success rate. However, from a statistical analysis performed with the available data, it has not been possible to find a direct correlation between improvement in the success rate and the evaluation method, which seems to indicate that other factors, such as budgetary control and/or educational administration guidelines, could also be involved.

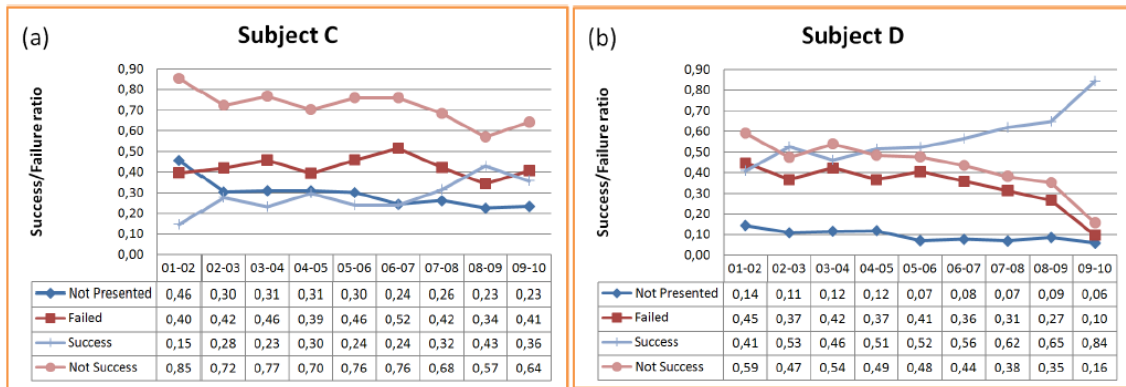


Figure 5: Success and not success ratios in sample subjects with evaluation methods 3 and 4.

Conclusions

One can think of a number of factors that influence the acquisition of knowledge by students. Much of these factors are directly related to the educational environment in which lessons are taught, while others, including those more personal are alien to that environment. The evaluation methods are a priori relevant factors of the first kind, having gathered in this study the most common assessment methods in the first cycle of the degree in aeronautical engineering.

Given the results above, there is no doubt that the academic performance in Aeronautical ETSI has experienced a remarkable improvement in considered years. Although the method of evaluation has been one of the factors contributing to this improvement, others such as budgetary control and/or educational administration guidelines should not be ruled out.

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